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Report of Proceedings



Fifth Conference

on

Maple Products

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October 23 & 24, 1962

EASTERN UTILIZATION RESEARCH & DEVELOPMENT DIVISION
AGRICULTURAL RESEARCH SERVICE
U.S. DEPARTMENT OF AGRICULTURE
PHILADELPHIA 18, PENNSYLVANIA

The Conference was held at the Eastern Utilization Research and Development Division with representatives of industry and government from the United States and Canada participating. The State Agricultural Experiment Stations, the Extension Service, universities, maple producers, processors and distributors, equipment manufacturers, state governments, and the U. S. Department of Agriculture were represented.

This report summarizes the discussions of the various speakers during the conference. Further details regarding any particular subject may be obtained by communicating directly with the person concerned (see appended list of names and addresses).

(1)

Tuesday, October 23

8:30 a.m. Registration

9:30 a.m. Welcome

P. A. Wells, Director
Eastern Utilization Research
and Development Division

9:35 a.m. Introductory Remarks

C. O. Willits, Head
Maple Investigations
Eastern Utilization Research
and Development Division

L. H. Sipple, Chairman

9:45 a.m. An Economic Appraisal of
the Central Plant for Sap
Evaporation

J. K. Pasto, Professor of
Agricultural Economics
and

R. Taylor
Pennsylvania State University
University Park, Pennsylvania

10:30 a.m. A Model Central Evaporator
Plant

R. P. Mears, Plant Manager
Northland Dairy
General Foods Corporation
Ewart, Michigan

11:00 a.m. BREAK

11:10 a.m. Twelve Years of Extension
Work with Maple Sirup
Producers

F. E. Winch, Jr., Extension
Forester
Cornell University
Ithaca, New York

12:00 Noon The National Maple Council

L. H. Sipple, Maple Producer
J. L. Sipple and Son
Bainbridge, New York

12:30 p.m. LUNCH

(1) On the day preceding this conference, the National Maple Sirup Council met here. For a report on this meeting see Mr. Sipple's paper.

Tuesday, October 23 (continued)

T. A. Peterson, Chairman

2:00 p.m.	Wisconsin's Maple Industry and Its Growth	A. Reynolds, Maple Producer Reynolds Sugar Bush Aniwa, Wisconsin and T. A. Peterson, Extension Forester University of Wisconsin Madison, Wisconsin
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2:45 p.m. PANEL DISCUSSION - Sanitizing
Pellets for Tapholes

R. N. Costilow, Professor of
Microbiology and Public Health
and

P. W. Robbins, Professor of
Forestry

Michigan State University
East Lansing, Michigan

Regional Participants

3:45 p.m. General Discussion

7:00 p.m. BANQUET - Casa Conti Restaurant
Easton and Jenkintown Roads
Glenside, Pennsylvania

Speaker - Wheeler McMillen
Vice President
Farm Journal, Inc.

Wednesday, October 24

J. W. Marvin, Chairman

9:00 a.m. Winter Tapping of Sugar Maples N. E. Beabes, Maple Producer
Hooversville, Pennsylvania

9:30 a.m.	Factors Affecting Sugar Sand Formation	J. HacsKaylo, Professor, and Dr. D. R. Davis Ohio Agricultural Experiment Station Wooster, Ohio
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Wednesday, October 24 (continued)

10:15 a.m.	The Maple Research Program at the University of Vermont	J. W. Marvin, Chairman Department of Botany University of Vermont Burlington, Vermont
11:00 a.m.	BREAK	
11:10 a.m.	The Maple Research Program at Macdonald College	A. R. C. Jones, and G. A. Jones Macdonald College of McGill University Quebec, Canada
11:55 a.m.	Concentration of Sap by Freezing	E. E. Stinson Eastern Utilization Research and Development Division
12:30 p.m.	LUNCH	

F. E. Winch, Jr., Chairman

2:00 p.m.	Maple Tree Diseases	M. E. Fowler, Chief Forest Disease Research Division U. S. Forest Service Upper Darby, Pennsylvania and D. R. Houston, Pathologist Forest Disease Laboratory U. S. Forest Service New Haven, Connecticut
2:45 p.m.	Microbiology of Maple Sap	A. E. Wasserman Eastern Utilization Research and Development Division
3:30 p.m.	Laboratory Exhibits	

WELCOME

by

P. A. Wells, Director

Eastern Utilization Research and Development Division

Dr. Wells welcomed the delegates to the conference. He pointed out that the present conference represents the fifth held at this laboratory on a triennial basis since maple sirup research was initiated here some 15 years ago. Other commodity conferences that started here, such as the ones on tobacco, potatoes and milk concentrates, have been continued on an annual basis under sponsorship of the respective commodity industries. A report of the present conference will be prepared, and each person attending will automatically receive a copy. Additional copies can be obtained on request.

INTRODUCTORY REMARKS

by

C. O. Willits

Eastern Utilization Research and Development Division

How little did we realize, 12 years ago when our first maple industry conference was held that we would be meeting today with more than 100 in attendance. Our original aim was to bring together all who make up the maple industry and then, as now, we had complete representation both from the United States and from Canada of producers, equipment and instrument manufacturers and suppliers, Extension Specialists, research workers (State and Federal), and sirup processors. While we were fully aware that the maple industry had seen little modernization take place over the years I am sure no-one suspected that we would see the remarkable changes that have taken place during these 12 years. Eavesdropping on a conversation between two producers at a recent summer maple tour, I heard one producer say to the other "sirup making is not like it used to be 10 years ago - it has been completely changed." We wondered at the time of our last meeting held just 3 years ago if there would be sufficient new developments to justify another of these triennial conferences. Again, so much has happened that it has been difficult to limit the number of papers to a two-day conference. Outstanding, among these newer developments that are having and will continue to have an enormous impact on the industry are: advent of the central sap evaporator plants; the serious problems presented by the maple tree dieback disease; development and commercialization of the taphole germidical pellets; acceptance of plastic tubing for the collection and transportation of maple sap; better understanding of the factors that control sugar sand formation; need for sanitation and for controlled fermentation of maple sap; formation of "The National Maple Sirup Council" an organization to unify, improve and represent the maple industry; and last but far from least the birth of a publication, "The Maple Sirup Digest," that is by and for

maple producers. The program of this conference has been arranged to cover these very recent developments. However, since this is your conference we always welcome your suggestions.

One might ask if this conference does fulfill these objectives - what is there left to be accomplished during the next three years. The answer is many things. We will see a build-up of the industry in the midwest, namely in Minnesota, Wisconsin and Michigan as well as in West Virginia and Indiana, for maple production can do much in these states as it has in others to help bring about rural area development. We will be better able to control the quality (color and flavor) of maple sirup through not only improved processes but through newly developed sap fermentation procedures. Fall or winter tapping may become an accepted practice. We will be provided a yardstick for predicting the amounts of sugar sand produced on any given farm and how it can be controlled, how to preserve sap so that it can be held for longer periods of time (a requirement of successful central plants) and we will have the much needed economic data, based on studies that are to be initiated, on sap production and sap processing.

A little change is always wholesome, so that the format of this conference has been changed somewhat. We have attempted to separate the ladies (guests) from the men by providing the ladies with their own program so they will not be required to sit through what might be to them dull and boring sessions of one technical paper after another. We hope that providing them with their own program will prove to be so popular that they will insist on coming to other conferences in the future. You will note also that the conference is to be chaired by a different person for each of the four sessions, and a banquet has been arranged for your pleasure. No doubt, you have already noted a display of interesting publications arranged in the hallway. These include publications from different states as well as those of this laboratory. A mechanism has also been provided for you to obtain these publications.

Editorial Note: More than 1,000 reprints were requested by the conferees.

AN ECONOMIC APPRAISAL OF THE CENTRAL PLANT
FOR SAP EVAPORATION

by

Jerome K. Pasto and Reed Taylor
Pennsylvania State University

(ABSTRACT)

Information gathered from the few makers of maple products who now purchase sap to supplement their own supplies, from the industry as a whole, and from manufacturers of up-to-date equipment, indicates that local evaporating plants serving considerable numbers of farmers would be an economical means of processing sap into sirup. Budgets were calculated for plants of three sizes, to accommodate varying conditions. All operating expenses, depreciation, and interest on capital invested were included in the costs of processing.

Plant A, the smallest, requiring an investment of about \$25,000, would produce about 8,800 gallons of sirup per season. At this plant, the total cost of evaporating sap of 2.4 degrees Brix would be \$1.69 per gallon of sirup. With sirup valued at \$5.00 per gallon, 9.2 cents per gallon of sap would be available to cover the cost of purchasing the sap, to provide for contingencies, and if desired, to pay a rate of interest on the capital higher than the 6 per cent included in the budgets.

Plant B, requiring an investment of \$32,000, would produce 13,200 gallons of sirup per season. Cost of operation based on 2.4 degrees Brix sap would be \$1.54 per gallon of sirup, leaving, for \$5 sirup, 9.6 cents per gallon of sap to cover the cost of the sap, contingencies and any return higher than 6 per cent on the capital.

Equivalent figures for Plant C, the largest, would be a \$39,000 investment, 17,600 gallons of sirup per season, operating costs of \$1.47 per gallon of sirup, and 9.8 cents per gallon of sap.

Processing costs per gallon of sirup fall sharply as degrees Brix of the sap increase. For plant size B, for example, the cost of processing falls from \$2.11 per gallon of sirup made from sap of 1.6 degrees Brix, to \$1.26 per gallon of sirup made from sap of 3.2 Brix. With sirup valued at \$5 per gallon, this means an increase from 5.4 cents to 13.9 cents in the balance left per gallon of sap.

For a detailed report on the Economics of the Central Evaporator in Maple Sirup Production, see Bulletin 697, The Pennsylvania State University, College of Agriculture, University Park, Pennsylvania.

A MODEL CENTRAL EVAPORATOR PLANT

by

Robert P. Mears
General Foods Corporation
Evart, Michigan

About a year or so ago, General Foods learned, through the U.S.D.A.'s Eastern Regional Utilization Laboratory and the Michigan State Extension Department, that there are many sugar maple trees in Northern Michigan which had not been tapped. Northland Dairy, being located in north-central Michigan, was asked to investigate the possibility of establishing a maple sap evaporating station to promote tapping the trees and stimulate interest in the production of maple sirup.

Evaporating water from milk has been our job at Northland Dairy for many years, so we had some degree of "know-how" when we tackled the evaporation of water from maple sap. At first we thought we could use our dairy equipment to haul sap and evaporate water, but this was not practical because of the large amount of sap to be transported and the time required to evaporate the water. We learned, also, that vacuum evaporation had been tried and was not successful in producing good maple flavor.

We finally decided to locate an evaporating station in an area where there was a large concentration of maple trees, so that sufficient sap could be obtained without long hauls. Investigation indicated that maple sirup production in Michigan is low because of the limited market, mostly roadside, and the investment necessary in equipment and housing. We talked with Extension personnel and others in northern Michigan, and it was their opinion that farmers would tap trees and sell the sap to us because during the sap season they have free time, and would not have to make a sizeable investment, boil the sap, or find a market for the sirup.

The Kingsley, Michigan area was chosen for the evaporating station. There are many maple trees in the area and in the past a large amount of maple sirup had been produced. Also, farmers in the area, and the Kingsley townspeople expressed interest in an evaporating station. Therefore, we leased the former pickle station and converted it into a central maple sap evaporating station.

To stimulate interest in tapping maple trees, and explain our sap-buying program, we participated in meetings that were held in the area. To directly contact farmers who were potential maple sap producers, we prepared a Brochure announcing that we would purchase maple sap delivered to our station. In the Brochure we listed our paying price: 4¢ per gallon of 2° Brix sap, with a .2¢ differential for each .1° Brix above or below 2°. A reply card was included, to be completed and sent to us by persons interested. Eugene A. Smaltz, Field Supervisor for Northland Dairy, who had charge of the Kingsley Maple Evaporating plant, as well as

Extension personnel and interested townspeople, discussed the details of our sap-buying program with all persons who replied, and the Brochures were placed in local business-places.

For the most part farmers used 30-lb. fruit tins and found that by punching a 1" hole in the side so the tin could be hung on a spile, these made very cheap sap collectors. For sap producers who needed financing, we agreed to make loans to be repaid in 2 years - one-half the first year and the other half the second year. Interest of 5% was charged on the second half. Repayment was made in the form of deductions from the sap checks. The local bank also agreed to finance producers. Also, we purchased spiles and sap buckets and sold them to suppliers at cost, since the local supply was limited.

For hauling sap from the woods to the station there were a variety of rigs used - the most popular being modified fuel oil storage tanks. A local shop welded two of these tanks together, making a total capacity of 550 gallons. When mounted on a trailer, farmers found these to be very satisfactory tanks in which to transport sap. Also, tanks which had been built for the cherry-growers for hauling cherries to the market at nearby Traverse City, were used for transporting sap, and these, too, were very satisfactory. There was a lot of cooperation between farmers in the project.

When sap arrives at the plant it is sampled and tested for sugar content by a refractometer (0 - 25° Brix) that compensates for temperature. The sap is then pumped by a positive-action pump from the gathering tanks, through a registering meter, and into a storage tank. This meter registers the number of gallons to the nearest 0.1 of a gallon. Sap storage tanks are cypress pickle vats, lined with polyethylene. The sap is pumped from the storage tanks to a gravity feed tank for the evaporators. The level in the feed tank is maintained by a float control connected to the feed pump. The standard float control is used to maintain the level in the evaporators.

For evaporating, we installed two 6' x 20' deep-flue pans, consisting of three sections each, so connected that the sap enters at one end of the first pan, and flows through both units, before feeding into a steam evaporating chest. Both pans are hooded with sheet aluminum, but instead of a wooden frame, the aluminum sheets were bent to give a 1" angle along the edge, which were then riveted together. The exhaust from both pans is piped to a common stack which goes through the roof of the building.

We built our own fire-arches, using fire-brick, insulation and concrete blocks. The first evaporator is equipped with two oil burners, having a total capacity of 40 gallons of oil per hour, and the second is also equipped with two oil burners but these have a capacity of 32 gallons of oil per hour. We use No. 3 fuel oil.

Sirup comes from the pans at about 25° Brix, and flows by gravity to a finishing pan (steam evaporating chest) - which is a former stainless steel milk pasteurizer, remodeled to make three sections through which the sap flows. Two sections contain one 2" stainless steel heating tube, and the final section contains two 2" stainless steel heating tubes, in which 50# of steam pressure is used.

A temperature controller, which uses the common thermo-couple as a sensing unit, is used for operating a solenoid valve for drawing off the finished sirup. This control unit has a differential of .3° F., and when set at approximately 219° F. we found it to be satisfactory as a draw-off device. (We checked finished sirup with a hydrometer to determine the exact setting we needed for the controller.)

The finished, unfiltered sirup is air-cooled in a stainless steel tank, then stored in cypress vats, polyethylene lined and covered, and ultra-violet lights are used over the sirup. By the end of the 1962 season, much of the sugar sand had settled to the bottom of the storage tank. Before shipping, the sirup was heated to 185° - 190° F. and put through a clarifier to remove the remaining sediment and sugar sand. It was then shipped out by tank car.

We got off to a slow start last spring because of the deep snow in the woods, and to some extent by the skeptical attitude on the part of some. However, it was not long before the attitude changed, - many people tapped trees and there was much enthusiasm. When the plant started we had many visitors at all hours of the day and night. Quite a few visited the plant at least once a day - it seemed to us that it had replaced the "General Store" as a meeting-place.

The local papers, radio and TV stations all gave us favorable publicity, all of which greatly helped to stimulate more tree tapping.

For each delivery of sap, the supplier is given a slip with his name, gallons of sap delivered, and the sugar content of the sap. They are paid on Wednesday for the sap delivered the previous week, so they do not have to wait until the end of the season, or longer, for their money. We think that encourages sap suppliers.

Interest in selling sap varied last season from the very young to the old, and in size from a few taps to 3200. The smallest in number, and the youngest, was a boy who started with 3 taps, delivering the sap in a wash-tub on a red coaster wagon, with the help of a girl and a dog. Later, he expanded to 15 taps, and had to borrow a milk can from us in which to haul sap. Two boys formed a partnership and obtained permission from some townspeople to tap their trees. They had 300 taps and their sap sales for

the season totaled \$311.75. They considered this good wages for after-school work. One of them purchased stone-polishing equipment with his earnings and is now selling polished stones. Next year they plan to have 1100 taps. The Methodist Youth Foundation of the Kingsley Methodist Church also obtained permission to tap trees in the area to earn money for their projects. They were very enthusiastic, seeming to have a lot of fun doing the work. One man, who had planned to sell 250 acres of woodlot for timber last summer, decided he would tap some of his trees. He found it more profitable to sell sap than to sell the timber, so he is not going to sell it, but plans to tap more trees next season. One of our most faithful suppliers was a 72-year old man. One supplier had a large tank mounted on a truck, and hauled sap as far as 70 miles.

Some sirup producers who had evaporators, brought sap to us when they had more than their equipment could handle. Some brought sap to us after they had made enough sirup for their usual trade. Others continued to make sirup after they had made sufficient for their trade and sold the surplus sirup to us. One thing they like about selling sirup to us is that it does not compete locally with their prime grade, and producers have indicated they plan to tap more trees in the 1963 season and sell us a larger volume of their tail-end sirup.

This year we received 242,000 gallons of sap, averaging 1.98° Brix, from approximately 22,000 taps. The sap we processed plus the sirup we purchased, totaled 7,500 gallons of sirup.

Visitors to the plant were interested in oil-firing as a very convenient, easy way to evaporate sap, but were surprised at the amount of fuel oil required. Others were interested in the ease of handling sap and sirup through pumps and with automatic controls. Many were disappointed, however, that they could not see the sap boiling, because our hoods had no sight-glasses. All were pleasantly surprised, though, that the plant was not full of steam. As a matter of fact, a Reporter from the Traverse City Record-Eagle called about taking pictures of the operation, but he asked, first, if he could get any shots of the evaporation process while the plant was filled with steam.

Looking forward to next season, we plan to refine our controls and make a few changes and improvements in equipment. If interest continues as it was this past season, we can expect more trees to be tapped and receive more sap and sirup next year. Some suppliers who tapped only a portion of their trees last season, plan to tap more next season; and others, who did not tap this year, plan to do so next year.

There were some "side" effects to the operation. A Machine Shop, as a result of this expansion and tree-tapping, has developed a spile, incorporating many improvements over those now on the market. The good feeling - romanticism, or whatever one wants to call it - and the

cooperation engendered among the persons who worked in this maple project has been very gratifying.

We had some wonderful cooperation from manufacturers and others who supplied equipment, instruments, specialized labor, etc. - many of them went "the second mile" to help us get started on this project.

TWELVE YEARS OF EXTENSION WORK WITH MAPLE SIRUP PRODUCERS
by
Fred E. Winch, Jr.
Cornell University, Ithaca, New York

According to our records the New York Extension Service has been holding meetings for maple producers since the early 1930's. Thus, this is no new program for the extension foresters to be handling. My earliest work with maple sirup was as a graduate student in 1936-37 when we were dealing with the problem of lead in sirup. I can remember the generosity of the producers at that time. Most would send in a quart for testing, but many would send a gallon. Then we would remove from the sample 1/2 cup for the test, and send him the results when this became available. All the extra sirup was divided up by the grad students and utilized by them and their friends. Needless to say, fairly large quantities of lead were consumed.

In 1944, I again became associated with the maple program largely on the management of the sugar bush. When I succeeded to the position of extension forester, I stepped into a program set up by my predecessor, J. A. Cope, that had been under way well over 15 years. Many of the ideas that were put into practice at that time have been carried on with little change, but some have been abandoned and others added.

In brief, our procedure in any year is to hold 22-24 county or regional training schools for maple producers at which we present the newest research information and re-emphasize the most important changes over the last few years. I think that our maple producers are about like those you'd find in any group -- about 3% are termed the innovators, 12% the early adopters, and these are the folks we get to try out and put into practice the new ideas presented; about 70% of the audience will come along eventually and about 15% never will change. These figures are for any one practice and not the group as a whole since some practices appeal to some more than others. It is with this top 15% of the audience that we work closely, either through the county agricultural agent or directly. Fortunately, we have this innovation group which is willing to accept the word of the agent, the specialist or the researcher.

We have used several sources (besides our own staff) of information in our program. One of these sources has been the staff from the Regional

Laboratory here which we use for 3-4 days each winter in rotated areas of the state; another is the use of motion pictures, our own and others; a third has been the representatives of chemical companies and equipment companies who present their ideas on the value and method of use of their products. Programs in any of our three regions will vary yearly based on the local needs.

After the discussion of these ideas at our winter meetings a period of time is devoted to sugar bush visits each spring, trouble shooting and assisting in installation or instruction of the use of new equipment or techniques. Usually we concentrate on two of the three major areas of the state.

Then the climax of the year's work is, even beyond making the crop, the "summer tour." Eighteen of these tours have been held. The first was a single automobile load of producers two regions taken to visit six other producers in the third region and to get together for an evening's discussion afterwards. In each of these tours we try to incorporate "a bit of vacation" as well as to get the meat that the 3% (the innovators) can give us by showing how these ideas do work. Each tour includes, as I said, a little "bait" so that it is partly vacation, mostly a chance to view the work of other producers, and most important - to discuss the new ideas among themselves, both pro and con. I might just cite our last two years' tours as examples. In 1961 we assembled in Lewis County and visited four producers in the Croghan-Belfort area. These included two with covered evaporators, three with new houses and several additional new techniques. We then had an evening meal - discussion of new material, and the next day was left free for travel at the St. Lawrence Seaway on their own. About 200 participated in the tour's first day -- over 100 at the evening program. The third day 80 assembled in Quebec to join Arch Jones, Extension Forester for this area, in visiting four producers and the MacDonald College experimental area. This year we assembled at a private recreation area in Allegany County, visited four producers the first day, an oil field and watched oil being pumped, and continued on to three more producers the next day. Nearly 300 participated in this tour.

During the period since 1950 we have developed our program in two distinct parts:

1. Production of sirup and this is broken down into:
 - a. Bush management
 - b. Sap and sirup production
2. Marketing of sirup and maple products.

Admittedly, we have done more in the production end of the work than in the marketing phases. We have had a continuing program on sugar bush management which has been broadly implemented by our C. F. M. foresters working out of the district forestry offices. Our bulletin by

Dr. R. R. Morrow, "Influence of Tree Crowns on Maple Sap Production" has been of great help in getting this into effect. It is interesting to note that nearly all our good producers are forestry minded and many are in the Tree Farm Program.

In the sap and sirup production program our main emphasis is to attempt to get the most sap and the highest quality sirup with the least expenditure of labor. This started off with a study of 50 farms in 1955 by Robert Bell. In his cost of production study, which has been previously reported on, we found we had a basis from which to emphasize the need for efficiency both in the gathering process and in the boiling process. We therefore gave a lot of time working on these aspects. In the bush we came to the bucket spinning technique, as required by plastic bags; then to labor saving as with plastic tubing.

Along with this, we began working on better techniques in the sugar house itself and we found that there were several approaches to this. Bigger or at least longer evaporators were developed by running two or more in series where one man could fire both evaporators. Man hours can be cut further by using oil or stoker-fed coal which is automatic and releases labor for other needs.

As with any idea and its adoption new roads are opened to further improvements. In the bush we learned that plastic bags gave better sap by inhibiting the bacterial growth. Thus field storage tanks for plastic lines are covered with plastic covers; storage tanks and sirup storage tanks are covered with ultraviolet lights for the same reason. To carry the sanitation idea further the use of chlorine sanitizers for tap hole use has been pushed for several years and opened up the way for larger and better quality crops.

Labor being a key cost factor, it was important to work towards lower gathering costs by elimination of back-breaking work. I can remember well the peculiar looks I got when I suggested the use of pumps to move sap. The first buyers of this idea used everything from garden tractor powered pumps to power take-offs on the farm tractor. The idea caught on and now manifold vacuum electric pumps and gasoline powered pumps are used widely in all sized operations. Gravity dump tanks also are used in some areas. Tubing has become common in many areas, especially when it can be demonstrated that a man and wife team can operate 2600-2900 taps on plastic line plus 600 buckets, 1/2 mile away from the bush, haul it in by tank tractor, empty the tanks in minutes by pump while his wife is firing and drawing sirup from a covered evaporator in an up-to-date sugar house at the roadside. Yearly production here varies from 950 to 1050 gallons.

In the sugar house itself, the need for better filters was long recognized both in design and in material. Thanks to flat filters which hasten the rate of filtration and synthetic fibers which clean easily we are now filtering sirup very well but even ahead of that are filtering sap before

it gets to the storage tank. Better testing equipment has been needed and is now available in the form of a Brix scale hydrometer that is easily read and the new Taylor 1/4° thermometers.

The last four years have really pushed us over the hump in technology. In this period have come the following:

1) Covered evaporators: starting with the "guinea pig" set up by Charles Hagar in Masonville, we have seen 25 the first year, nearly 100 the second year, and about 200 of these in 1962.

2) Batch pans: thought to be retrogression by many, we now see many batch pans in use as labor saving devices and quality control units. There are over 300 in use in 1962, some homemade, some purchased.

3) Sugar kitchens for cream and sugar production show progress in production and in better marketing. There are nearly 300 of these in the state at the present which incorporate the mechanical stirrers, for maple cream or maple butter, the sugar machines and a good sales room. Not all 300 are the ultimate but they are there and represent a step in the right direction. The best are part of the roadside sugar house.

4) Roadside sugar houses which have come into being to enable the operator to handle larger production from several bushes and to buy sap. There has been a decided trend to these and away from the bush. They are an advertisement for the producer and are useful year round. There are nearly 400 of these now of all sizes ranging from cinder block construction to rustic types.

5) Tap hole sterilization with pellets was started in 1962 and this was accepted wholeheartedly. Preparation for this was carried out by emphasis on other compounds and methods in previous years. Over 950 of the larger producers have used these in at least part of their set up and about 1/3 used pellets in all taps this year (and with excellent production).

6) Buying of sap has come on fast. Approximately 130 producers buy from 1 to 15 others. This is good business and is growing thus enabling the expert sugar maker to utilize his skills to a higher degree and expand his marketing.

7) Conversion to oil is continuing at a rapid rate; with cost of labor up; saphouses at the roadside, and purchase of sap increasing, several operations are running 24 hours per day during the season. This enables one man (or one woman) to operate the boiling end of the enterprise.

8) Better testing devices especially the new 1/4 degree F. thermometers of which there are over 40 in use now make better and more accurate sirup and maple products.

With all these techniques coming along, we have seen production rising on individual farms. We are in effect, in 1962, reaching toward central evaporator houses. Three of our producers total (collectively) produce over 15,000 gallons. Fifty-six producers are now in the 1,000 gallon class or larger and these 56 totaled 89,000 of our states 550,000 gallon production which is made by about 1600 commercial producers.

To help carry this upper group a step beyond their present knowledge, we held a school in Western New York to bring new ideas and techniques for the producer who is considering expansion and going further into marketing. We hope this idea will be spread to other areas over the next couple of years.

Within this period we have had three Associations formed which are carrying on a supplemental program largely on promotion and in the last few years largely self-propelled. They are united as the New York State Maple Producers Association. It is my policy to stay out of the guiding position in such organizations; they have therefore carried the ball and done very well, but as usual enroll only a small portion of active producers who do not realize what a fine job has been done by this group of men.

What about the marketing program? We do not hold a candle to our neighbor to the Northeast -- Vermont. They sell sirup! Many of you are not acquainted with the way to sell maple, if so, drive through the state of Vermont. We are way behind and for several good reasons.

Vermont has large supplies of sirup which is purchased for remanufacture. Larger organizations handle the marketing and do a fine job. In our state this job has been seasonal. The pattern has been make it, sell it, and forget it till next year. We are changing. Several of our folks, not quite all the 3% innovators, are doing a job of marketing on a year round basis and we have made progress. We have tried new ideas and new products; maple is becoming known. The producers associations have had help. Our State Departments of Agriculture and Markets and of Commerce are placing emphasis on this product and in response to our producers requests, some excellent promotional ideas are being worked out.

One of the strengths of our program, I believe, is that we have developed a program for the maple producer family. We have husband and wife teams, father and son (including in most cases wives of both) who are working together and these teams have strengthened the family farm approach. Since field work and sugar kitchen work go hand-in-hand we have seen this family operation spreading into year round activity which has strengthened the whole financial structure of the family. It can be further expanded as well.

In closing, I would emphasize that the extension program has had some successes, probably we have forgotten or overlooked our failures, but it

has been with the philosophy of extension we have succeeded: train the leaders and innovators and use them as demonstrators and disseminators of information. To these people belong all the credit for developing the "on-the-ground" program.

THE NATIONAL MAPLE SYRUP COUNCIL
by
Lloyd Sipple, President of Council
Bainbridge, New York

The National Maple Syrup Council was born at the Fourth Maple Conference held here 3 years ago. At that time, the delegates who participated felt there were many reasons why we should have a national organization, but there is one which many of us consider the most important. As you know, industry of all kinds spends billions of dollars every year on research. The maple industry is handicapped in this field because there are about 9,000 producers in the United States, none of them large enough to be able to afford the cost of much experimenting on their own, and they are unorganized. This laboratory and the various state experiment stations are doing a good job in research for the maple industry, and some kind of an organization was needed to serve as a link between research and production.

With this thought in mind, the delegates who attended the fourth Maple Conference laid the foundation for the organization of the National Maple Syrup Council. At that meeting, Milton Thibaudeau of Wisconsin was elected acting chairman and Dorothy Zimmerman of Pennsylvania was elected acting secretary.

The first annual meeting, held in Burton, Ohio in October 1960, was primarily to organize the Council. The constitution was adopted at that time and a membership fee was set at \$25 per year for each maple producing state. Many topics were discussed such as a national grading law for maple sirup and the threat of the maple disease which is becoming so prevalent. Officers elected for the year 1961 were Milton Thibaudeau, President; Lloyd Sipple, Vice President; and Dorothy Zimmerman, Secretary and Treasurer.

The second annual meeting was held in October 1961, in Luxemburg, Wisconsin. Reports and discussions continued on the national grading law, the maple disease, tap hole pellets, and all other timely topics. At that meeting, the delegates realized that the council had a job to do! That job was to take information obtained from the various research centers and pass it along to the maple producers. When you have a job to do, you usually need a tool with which to do it.

The extension foresters and county agents have done a wonderful job of educating the producers, at least in some states or areas. But the extension service can only educate the producers who will cooperate and attend the maple schools. There are also many areas where production is scattered and no maple schools are held. Some maple schools take so much time electing maple queens and arguing about the price of sirup that they don't have time to talk about such things as the new tap hole pellets, or how to build a cover for the evaporator.

The delegates felt that some sort of newsletter mailed to every known producer would at least put the information they wanted before them. Whether they read it or get any benefit from it would be up to them.

However, publishing a newsletter is a real humdinger of a problem. How could the material be gathered together, edited, printed and mailed, and how could all this be financed? Prior to the meeting, I had obtained some information on the cost of such a publication and had the promise of a substantial amount of backing in the form of advertising space from our good friend Bob Lamb. After a brief discussion, the Council dumped the whole thing in my lap and said "go to it." So there I was with an estimate, a promise, everyone's good will, but no mailing list.

Well, one thing led to another and finally, on January 10, 1962, the first issue of the "National Maple Syrup Digest" was ready to mail. 9000 copies were printed, 5200 mailed directly to producers and most of the balance distributed by extension foresters, county agents, etc.

About this time I realized that another issue must be mailed before tapping time, and on February 10, the second issue was ready to mail. 6100 copies were mailed directly to producers and the rest distributed as before. Since no one would have time to read the "Digest" during the maple season anyway, and some meetings in the Spring caused further delays, the third issue was not ready to mail until the first of August. By then, the mailing list had grown to 7000, so 9500 copies were printed.

The first three issues of the "Digest" cost \$3076.23. We received \$2910.80 from advertisers and \$194.00 in contributions from maple producers and others who felt the "Digest" was worth their assistance. We sold \$15.00 worth to Cornell University which leaves a balance of \$43.57. The contributions and letters of appreciation we have received have proven one thing - The "Digest" is well accepted, well read, and must be continued.

This brings us up to the Third Annual Meeting held in this Laboratory on October 22, 1962. At that meeting eight states were represented, the two new members being Michigan and New Hampshire. With the addition of these two states the Council now represents at least 95% of the maple producers of the United States.

An amendment to the Constitution of the National Maple Syrup Council was approved. This Amendment is worded as follows:

"ARTICLE III, MEMBERSHIP:

The membership of the Council shall consist of all maple syrup producing states which have paid their dues and have been accepted as members by the Council. Each state will be represented on the board of directors of the Council by one delegate and one alternate delegate, both delegates must be primarily maple syrup producers, elected by the maple producers association of that state (or a group which represents the maple producers in that state.) The National Council will not be responsible for the expenses of any state delegate. Each state will be allowed but one vote on all business of the Council. Associate members of the Council need not be maple syrup producers, and are appointed by the Council. These members will not vote."

Dr. Willits gave a brief account of what had been done on the permanent color standards (Grading Sets) and other precision equipment such as refractometers and hydrometers. The Council is working on a plan to set up a system wherein they would either approve or disapprove the use of various articles of equipment, and thereby insure the producer who purchases a piece of equipment, that it is not a piece of junk that won't do the job it is supposed to do.

Mr. David Humphrey of the Office of Rural Area Development spoke on the part his organization can play in the maple industry.

Adin Reynolds, representative from Wisconsin gave a brief talk on some problems of marketing which he has encountered and led a discussion which brought us into the problem of the importation of Canadian sirup, the difference in the value of the Canadian and United States dollar and the tariff on maple sugar. At this time, Eric Nye, representative from Vermont, presented several recommendations pertaining to the same subject and drawn up by those persons attending a meeting in Montpelier, Vermont, on October 15, 1962.

To instigate action on this problem, the Council passed the following resolution:

"Whereas, the present United States duty on Canadian maple products does not reflect the lower cost of maple production in Canada:

Since it now represents less than 5% of the value of the product, and since this is now obviated by the 7-1/2% difference between United States and Canadian currency, be it resolved that the National Maple Syrup Council take appropriate steps to afford the domestic maple producer a measure of protection from this unfair Canadian competition by working toward the

enactment of an adequate ad valorem duty or by restriction of Canadian maple importations by imposition of a quota system."

Eric Nye, Vermont and Linwood Lesure, Massachusetts were appointed to process this resolution.

John Zimmerman, Stoystown, Pennsylvania gave a report on the maple disease - what progress has been made, and the need for appropriations for additional research. In recognition of the importance of continuing this research, the Council drew up and adopted the following resolution:

"The National Maple Syrup Council meeting in executive session October 22, 1962, at Philadelphia, Pennsylvania, representing eight maple syrup producing states from New Hampshire to Wisconsin, recognizing the damaging conditions affecting the sugar maple trees throughout the whole maple range and the serious threat to the production of maple syrup, maple timber and shade trees, hereby call to the attention of the United States Forestry Research Advisory Committee and the Directors of the Agricultural Experiment Stations of the Land Grant Colleges and Universities, the need for early concerted action to investigate the causes and the possible controls, if any, of these damaging conditions:

Hereby resolves that action be taken by the appropriate organization to set aside monies as provided by the McIntyre Bill for the investigation and the coordination of Pathology, Entomology and Soils along with other related fields, to solve the problems."

The Council has already taken action to place this resolution in the hands of the proper agencies.

Nine associate members were appointed by the Council. They are:

Fred Winch, Extension Forester, New York
Ed Farrand, Extension Forester, Pennsylvania
Ray Foulds, Extension Forester, Vermont
Leland Schuler, Extension Agent, Ohio
Robert Lamb, Distributor, New York
Robert Huxtable, Distributor, Michigan
Ted Peterson, Extension Forester, Wisconsin
Ken Barraclough, Extension Forester, New Hampshire
One from Commercial Processors to be appointed at the next annual meeting.

Officers elected for the year 1963 are: Lloyd Sipple, New York, President; Linwood Lesure, Massachusetts, Vice President; Putnam W. Robbins, Michigan, Secretary & Treasurer.

The Council decided that due to its financial status, production of the "National Maple Syrup Digest" would have to be done as it was last year. No funds are available which can be used to pay an editor. The "Digest" will be published in November, January and February and all Council members and associate members are to assist in procuring advertisements and articles.

The next annual meeting of the Council will be held in New York State in October 1963.

WISCONSIN'S MAPLE INDUSTRY AND ITS GROWTH I X
(Part I)

by

T. A. Peterson

University of Wisconsin, Madison

A. Wisconsin's Maple Industry

This assignment which is a responsibility I share with Mr. Adin Reynolds, Aniwa, is to report on Wisconsin's maple industry and its growth. Within our allotted time, we want to appraise the state industry status and to expand on two maple promotional projects.

Three years ago I had the good fortune of attending the maple conference here at the Laboratory. At that time I outlined the promotional program under way in Wisconsin for maple products. Many of my previous conference remarks concerning our industry's status and potential are still pertinent today. Let me summarize briefly. We are tapping less than 5% of our maple resource, whether you base this figure on maple acreage or tappable trees. In recent years, according to Census figures, the annual crop has amounted to approximately 100,000 gallons of sirup from 300,000 to 400,000 trees. Seventy per cent of our commercial forest land is privately-owned, which means that the maple crop can represent an important supplement to annual income -- especially on farms. As an extension Forester I am personally excited about the challenge this native forest resource represents to the people of our state.

As is true of all maple regions, Wisconsin's maple industry was initiated primarily as a farm family enterprise. A century ago seventy per cent of the state's maple crop (275,000 gallons in 1860) was in the form of sugar -- a staple item of the household. The small family farm enterprise still represents the largest segment of the industry, however the "non-farm" element will make up an ever-increasing portion in Wisconsin. Recent Census of Agriculture figures, I am quite certain, do not reflect this important "non-farm" segment particularly when the sampling has excluded the largest central evaporation plant in the nation.

B. Wisconsin's Maple Industry Growth

A statement regarding industry growth assumes a previous "benchmark" from which to measure development. Unfortunately this base is not available for Wisconsin. I can, however, cite a few generalizations to indicate trends which are taking shape.

The past 5 years and more have witnessed a "retooling" of many small maple operations in the state. This has not proceeded to the extent desired or necessary, however it has been a hopeful sign of the adoption of improved technology. Representatives of equipment companies have been very cooperative in the educational program for maple producers in Badger-land. Much credit for our progress in this direction is due to the research work and persistent prodding of the Eastern Regional Research Laboratory staff.

The "non-farm" development of central evaporator plants has shown a marked increase in recent years. Prospects are very good for several additional small to medium-size plants within the next few years. This idea is not new in a dairy state where milk is produced on farms and sold to central processing plants. Nor is the central plant idea new in the maple industry. Perhaps one of the earliest -- if not the first -- and the largest operations of this kind was established at Aniwa, Wisconsin by the Reynolds family.

The central plant idea is a sound approach to the expansion of the maple industry. Significant increases in the state industry will be brought about largely through these plants.

At the present time the required capital investment is difficult to obtain by interested local people. Low interest, long-term loan arrangements are being explored to expedite construction of these plants, and to underwrite the necessary modern equipment for gathering and handling sap. (e.g., FHA "forestry" loan, and RAD).

Industry is characterized by available resources, technology, and enterprising people. Let me briefly cite a case-history in Wisconsin. Price County is located in north-central Wisconsin. Forestry and recreation are major assets of the economy. Several years ago a survey was made of the maple trees in this county by A. J. DeVriend, county Extension Forester. It was estimated that adequate potential and interest existed for the initial establishment and the future expansion of a central plant.

Sixteen sap producers agreed to collect and sell sap from 10,000 trees within 15 miles of the plant which was established at Ogema. Mr. Ray Norlin and Lewis Motley are partners in this new venture. The sap collectors utilize buckets, bags, and tubing. Taphole pellets were used by all producers last year -- the first year of production. One half of the sap producers delivered directly to the plant. A plant tank truck picked up the remaining sap at collection points.

At the central plant, the sap was pumped into a 12,000 gallon concrete stove storage tank. Sap was gravity fed to a small wood-fired evaporator which was used for initial boiling, then pumped into a 6 x 20' oil-fired evaporator fitted with a steam hood. A finishing pan was used to complete the operation prior to final filtering and canning.

This is one example of the development and expansion of the maple industry in Wisconsin. In this case, private capital alone was utilized, and 18 individuals in the area were effectively involved. The story could be repeated many times if investment capital was more readily available.

C. Wisconsin Maple Producer Questionnaire - 1962

In order to better appraise the state maple industry, I recently mailed out a questionnaire to producers on our mailing list. Complete returns are not in, but I have summarized the replies of 163 respondents. If this topic is ever reassigned to me in the future, I will have a "benchmark" to measure industry development in the state. Results of this questionnaire will be most helpful in the state educational and assistance program for our producers.

One part of the questionnaire dealt with the woods operation. The producers reporting indicated 185,000 taps were made in 1962 compared with 105,000 taps five years ago. Ten per cent did not tap last year because of snow conditions, military service, and other reasons. This small sample of producers includes farm and non-farm producers who can be classified as (1) commercial producers and (2) "hobby" or "home-use only" producers. It is significant to note, since it reflects the potential alluded to in my initial remarks about the industry, that these 150(+) producers estimated they could make another 110,000 taps. This alone represents a 25% increase in total trees tapped!

The median figures indicate about 20 acres of trees are tapped per operation; 500 taps are made, compared with 300 taps 5 years ago; 300 more taps could be made per operation. Many respondents have relatively small operations and 2/3 report the use of a brace and bit for tapping trees. The large producer has readily switched to mechanized tappers.

Producers are using a number of sap collection methods simultaneously. This perhaps reflects the expansion of operations and retooling with modern equipment. It is somewhat disconcerting to find that as many as 50% still use open sap containers, 45% report the use of buckets and covers, 25% use some plastic bags, and 25% use some tubing.

Even though the taphole pellet was released for use late in the 1962 season, 40% of the respondents reported the use of some pellets. (From 10% to 100% of the taps in any one operation). The season in Wisconsin, fortunately or unfortunately, was not a good one to test the merits of the pellet.

A second part of the questionnaire dealt with the saphouse operation. Of those reporting, one-third still use open pans for boiling. This includes many of those producers we can classify as "hobby" or "home-use only" sirup makers.

Seven per cent of the producers use oil for fuel. The trend toward larger operations will definitely be toward oil, particularly where labor must be hired to put up wood.

Four covered evaporators were used by respondents of this small sample. The hesitancy to "cover up" the evaporator is beginning to wane and I look forward to a greater acceptance of this innovation. Producers who are building new saphouses are definitely considering this in their plans.

Producers utilize one or more test instruments for checking sirup density. Apparently there is real reluctance to completely accept new instruments and drop the old. 53% of the producers use the Baume hydrometer, 26% use the Brix hydrometer, 21% use the dial thermometer, 21% use the mercury thermometer, and 13% use an automatic draw-off. A combination of two or more instruments is commonly used.

The wool felt bag is used by 2/3 of the producers reporting. The flat, synthetic filters find greater preference among larger producers. Many sirup makers reported the use of more than one type of filter material. About 50% use a separate finishing system rather than finish on the evaporator.

A third section of the questionnaire dealt with the packaging phase of the operation. 90% of the respondents retailed sirup, with 40% selling up to 1/2 of their crop, and 60% of these selling over 50% of their sirup. Sixty per cent of the producers wholesaled sirup, with 60% selling up to 50% of their crop this way, and 40% wholesaling over 50% of their crop. Only 8% of the producers made confections. It is worthy to note however, that interest is high in learning how to make candies and creams.

Perhaps indicative of much of the maple industry, relatively few sirup makers know what it actually costs to produce a gallon of sirup. Less than 20% of the respondents had costs figured out for their operations. The vast majority are very interested in getting cost records assistance.

Wisconsin has voluntary grading. Only one-third of the producers who re-tailed sirup last year used a grade label. This represents one phase in producer-consumer marketing which must receive increased attention.

D. State Fair Industry Exhibit

Representatives from other maple states and Canada might be interested in an approach we have used in Wisconsin to publicize the state maple industry.

We are frankly working very diligently to dispel the mistaken notions many of our folk have that maple sirup comes only from the eastern states and Canada.

The Extension Forestry Office and the state maple industry represented by the Reynolds family has erected a 70' x 10' exhibit which tells the maple story from woods to salesbooth. A few slides will give you a better idea of this exhibit than just a word description. Briefly, we have tried to make the display as realistic as possible.

Starting from the maple woods, large tree sections were trucked in and set up. Maple saplings are interspersed with evergreens - the latter for effect rather than realism. Forest leaf litter covers the ground area. A split rail fence surrounds the woods. The sap collection techniques from early wooden troughs to plastic tubing are demonstrated. Spiles drip "sap" realistically during the 9 days of Fair. Whenever possible a person is on hand to answer questions and tell the story.

Next to the woods is the "evaporator house" complete with a 9 foot evaporator. This is gas-fired and steaming. An automatic draw-off and pumping arrangement circulates the "filtered sirup" back into the float valve intake of the evaporator.

The cabins were built of red pine poles, axe-whittled to perfect fit by a Finnish woodsman. Shake were made from discarded western cedar utility poles.

A "candy kitchen" demonstrated the finishing unit and bottling tank. Adin Reynolds was constantly making sugar candy for demonstration and sales. He can personally claim few spare moments during the entire fair.

The sales booth area displayed the various maple items for sale in various containers and packages. Maple sundaes competed favorably with red cherry sundaes across the way.

Those who have been active participants in this industry exhibit feel it has real educational value for the consuming public.

WISCONSIN'S MAPLE INDUSTRY AND ITS GROWTH . (11) . X

(Part II)

by

Adin Reynolds, Maple Producer
Aniwa, Wisconsin

Wisconsin has climbed from the seventh largest maple producing state in the United States in 1954 to the third largest in 1959. Much credit for this progress is due to the information and better "know-how" developed through the research activities of Dr. Willits and his staff here at the Eastern Regional Laboratory. The special interest in maple by the county agricultural agents and the Federal Forest Service have played an important part in the growth of the industry. Men like the recently retired Fred Trenk and the new extension forester, Ted Peterson, have done a great deal toward spreading the new methods and helping to modernize the industry.

Developments such as the central evaporating plant are important to the economy of the State. There are now about a dozen in operation and several more are in the process of being set up. The central evaporator plant allows the small operator or tree owner to realize an income from his operations, whereas the amount of money necessary for the investment would rule out establishing a complete operation.

The central evaporator plant could help areas that suffer from low income. There are entire counties in this category, yet they may well have a million maple trees that could be tapped. Using a low estimate of \$1 of income per tree for sap, it is conceivable that many thousands of dollars could be brought into the area.

We operate two central evaporating plants about 20 miles apart. One of these has been well supported since 1946. The success of the central evaporating plant definitely depends on marketing. As an illustration of this, prior to 1961 Wisconsin imported many hundreds of drums of sirup from the eastern states and Canada to supplement its inadequate supply. Since then the 1961 and 1962 crops have been so good that it has not been necessary to bring in sirup from out of the state.

One of our promotional efforts has been a maple sirup festival. This is not a new idea, and other places, like Ohio for instance, have excellent records for their festivals. We started out originally with four neighbor ladies helping out, but now there are 56 people employed to handle the 4000 visitors. Although this started as an individual affair we now invite the co-operation of others. There are many other attractions - a sirup-judging contest to which other producers are invited to submit entries, food demonstrations involving recipies using maple sirup, equipment displays, and exhibits by local merchants. There is entertainment supplied by the TV station and local talent. There are noted personalities as

speakers; the Governor of the State has been a visitor and a feature attraction is the Wisconsin Dairy Queen in "Alice in Dairyland." There was even an antique auto show through the courtesy of Bob Huxtabla, the Michigan equipment dealer. The main attraction is the Pancake Feed - via the production line system. The griddle is 2' wide and 44' long, divided into 2 sections. A 36' power driven conveyor runs between the griddles. There are 2 power batter mixers and 4 power batter dispensers which travel on rails above the griddles. Since we use a potato batter we also need a potato grinder to help in preparing the batter. The eating tent is 120' long and contains 4 tables. We can feed 15 people a minute with this set-up.

We feel that this Festival idea has contributed to the maple progress in the state of Wisconsin.

SANITIZING PELLETS FOR TAPHOLES

(Part A)

Microbial Inhibitors for Maple Tree Tapholes

by

Ralph N. Costilow, Michigan State University, E. Lansing

Microorganisms of all types are widely distributed in nature; and any one of many types will cause stoppage of sap flow from maple trees as well as reduce the quality of the sirup produced from the sap. However, in order to have a significant effect on sap flow these microscopic organisms must reach high population levels since they appear to interrupt the flow by physical blockage of the vessels. The time required to attain such numbers depends primarily on the mean temperature; and, to some extent, on the numbers present initially. This means that even if the taphole was free of microorganisms initially, reinfection with small numbers, which is almost impossible to prevent, would still result in a loss in the quantity and quality of maple sap. During warm weather, the bacteria, yeasts and molds multiply at a rapid rate and the numbers initially present have little influence on the time of stoppage of sap flow. However, during cold weather, the rate of reproduction is much slower and the number of cells initially present will greatly influence the time required to stop sap flow.

From the above, it is obvious that any compound that is going to be very effective in controlling microorganisms in tapholes must be active against a wide variety of microorganisms, and must be present in the taphole for most of the season. These characteristics eliminate the possibilities for using such agents as antibiotics and most of the approved food preservatives because of their limited spectrum of activity. Also, the reliability of hypochlorite (chlorox) solutions for rinsing tapholes

is questionable since this agent is destroyed rapidly when placed in tapholes and it could only serve to reduce the numbers of microorganisms present at the time of treatment.

The potential toxicity of most agents having broad antimicrobial spectra greatly limits the possibilities. In fact the compound paraformaldehyde, a solid polymer of formaldehyde, was the only one thought of in this laboratory that fulfilled these requirements. Extensive studies on microbial inhibition by a variety of formulations of this compound demonstrated that it would indeed do an excellent job in controlling microorganisms in maple tree tapholes throughout a tapping season. This control resulted in large increases in yield (up to 80%) during warm maple sap seasons, but had but little or no effect if the weather was cold through most of the season.

Pellets made with paraformaldehyde suspended in agar were found to be superior to pellets made by application of pressure from the standpoint of structural integrity and solution rates. Pellets made by pressure without adding a binder such as casein or gum arabic were superior in these characteristics to those made by pressure with a binder.

A number of sizes of pellets were tested and it was concluded that one containing about 0.25 g. of paraformaldehyde was adequate to control microorganisms throughout the season if properly pelletized.

Finally, a great amount of work on residues demonstrated that 72% of 901 sap samples examined during three seasons had less than 1 p.p.m. residual formaldehyde and only 1.2% contained over 10 p.p.m. No sirups made from sap from treated tappings contained over 1.6 p.p.m. formaldehyde and 38 of 45 sirups examined had formaldehyde levels of less than 1 p.p.m. This led to a tolerance level of 2 p.p.m. formaldehyde in maple sirup being established by the U. S. Food and Drug Administration.

A number of errors have been made in testing paraformaldehyde pellets for disintegration and effectiveness. It is not a fair test to place a pellet in a glass of water at room temperature. The taphole does not have nearly the volume of sap in it that is present in a glass of water; and more important, the mean temperature of a taphole during the tapping season, on an average, is much lower than even a household refrigerator. Both the temperature and the volume greatly affect the rate of solution of the paraformaldehyde. From the standpoint of effectiveness, the least variation will be encountered by selecting trees with two tapholes and treating only one with the pellet. This will eliminate the tremendous tree to tree variability.

The data for this presentation are reported in more detail in the following publications:

1. Identification of Microorganisms from Maple Tree Tapholes.
J. M. Sheneman and R. N. Costilow
Food Research 24, 146-151 (1959)
2. Correlation Between Microbial Populations and Sap Yields from Maple Trees.
J. M. Sheneman, R. N. Costilow, P. W. Robbins, and J. E. Douglas
Food Research 24, 152-159 (1959)
3. The Efficiency and Practicability of Different Types of Para-formaldehyde Pellets for Controlling Microbial Growth in Maple Tree Tapholes.
R. N. Costilow, P. W. Robbins, R. J. Simmons, and C. O. Willits
Michigan Agricultural Experiment Station, Quarterly Bulletin 44, 559-579 (1962)

SANITIZING PELLETS FOR TAPHOLES,
(Part B).

Sanitizing Pellets for Control of Microorganisms
in the Maple Tree Taphole
by

Putnam W. Robbins, Michigan State University, E. Lansing

You no doubt have been asked, "Does tapping reduce the growth of a maple tree or do the new paraformaldehyde pellets reduce the growth of the maple tree."

We know from field examination of the tapholes that a damaged area in the form of a narrow band directly above and below the taphole results from tapping. Therefore we are aware that the lumber in the butt section of the first log from a tapped tree produces lower grade lumber. However, we also know that the value of the maple sap produced from a tapped tree offsets the loss in the lumber de-grade.

A good quality maple forest should be growing at the rate of three per cent compounded annually. Therefore, a one-acre stand of maple trees in a sugar bush which contains a total standing volume of 7,000 board feet, should produce 210 board feet per year. If we are using cubic feet as our measurement a volume of one standard cord per acre per year is a fair growth rate.

A stand of sugar maple trees in the 80 acre "Baker" woodland on the campus of Michigan State University, which has been tapped in our research program in co-operation with the Agricultural Research Service at Philadelphia, offered the opportunity to record growth data. Over a nine

year period, the trees used in the study have grown at better than three per cent compounded, (actually 3.2 per cent) while at the same time producing during four years of the nine a total of 3,700 gallons of maple sap.

A group of trees in the two and three bucket classification, which received treatment of paraformaldehyde pellets of varying number and concentrations during the period from 1956 to 1961 contained a volume of 2,617 cubic feet in 1956. These trees had increased in volume to 3,092 cubic feet in 1962, which is an increase of almost three per cent, compounded per year over the growing period. These trees in addition to this growth produced a higher yield of sap per tree than the trees which were not treated with paraformaldehyde.

SANITIZING PELLETS FOR TAPHOLES
(Part C)

✓ Results Obtained With Taphole Pellets
During the 1962 Sap Season

A Report by States and Canada

Massachusetts - It was reported by L. B. Lesure that the Massachusetts season was apparently ideal for showing benefits from the taphole pellets. Fifty-six producers, each of whom used 500 - 1,000 pellets, reported greatly increased sap yields and prolonged sap flow. Although no firm conclusions can be made with regard to effects on bore healing in this short period there appeared to be no deleterious effects on healing. Because of the prolonged sap flow, pellet users were warned to discontinue sap harvest before the onset of problems normally associated with late season sap collection.

Professor Kirby Hayes reported that the Massachusetts Food and Drug officials had encountered no consumer complaints, had found no harmful residues, and in general viewed pellet use as an overall benefit.

New York - Mr. B. C. Buell's comments were based on replies to a questionnaire which was sent to 600 maple producers. Between 57 and 69% of the producers in the three major maple areas used pellets. Beneficial effects, mostly on the basis of increased sap yields, were reported by 85 - 90% of the users and the other users reported no noticeable benefit. It was concluded on the basis of these reports that pellet use had been beneficial but no accurate data were obtained on quality and quantity improvement. This will be studied more completely next year. Spot checks of samples in the retail markets, supplied by producers who used pellets, failed to disclose traces of formaldehyde in the sirup.

Mr. L. H. Sipple reported that one producer in his area had obtained a 4,200 gallon sirup yield from 9,000 pellet-treated tapholes whereas his

highest yield in previous years had been 4,000 gallons of sirup from 12,000 untreated tapholes.

Ohio - Mr. L. D. Schuler indicated that about 185,000 pellets had been distributed to maple producers through maple schools and direct contact. The average increase in sirup yield was about 20%. There was some damage to the taphole but this was not attributed entirely to pellet use.

There was absolutely no damage to Ture Johnson who was on hand to report that he had publicly drunk a glass of water in which taphole pellets had been soaked.

Pennsylvania - Extension Forester, E. P. Farrand reported that pellets were used in Pennsylvania on a trial basis. Results were variable in that some users obtained a prolonged sap flow while others did not notice much difference. Mr. Farrand felt that he was not in a position to comment on taphole healing on the basis of only one year's experience.

Vermont - Mr. F. M. Laing reported much variation in results and hesitated to draw any conclusions on the basis of only 1 year's experience. Some producers, who were enthusiastic about their particular results, will use more pellets in the future. Mr. Laing indicated that the scar stain from pellet-treated tapholes was larger (but different) from the stain associated with the untreated taphole. It appeared that the rate of taphole healing in the second year was about the same for pellet-treated and untreated tapholes.

Mr. F. Ayres asked if the exclusion of air from the taphole was beneficial in reducing microbial contamination. Dr. Costilow replied that microbial contamination of the taphole occurred at the time of boring. Microbes, because of their microscopic size, could also enter the taphole through minute channels along the spile. Complete exclusion of microbes by physical means was considered to be virtually impossible.

New Hampshire - Mr. K. E. Bascom suggested that it would be helpful if the pellets could be colored to facilitate their detection when dropped in the snow. Dr. Costilow replied that he had been unable to come up with a good practical solution to that problem as yet.

Canada - Mr. G. A. Jones indicated that he would discuss his experiments with paraformaldehyde pellet-treated tapholes in detail in his formal presentation. (This is summarized later in these Proceedings). For this brief phase of the program he stated that his results did not confirm the increased sap yields indicated by many previous regional reporters.

SUMMARY

It appears that the effectiveness of paraformaldehyde pellets is largely dependent upon the temperatures encountered during the sap season. To

quote Dr. Costilow: "This control (of microorganisms) resulted in great increases in yield (up to 80%) during warm maple sap seasons, but had little or no effect if the weather was cold through most of the season."

Injury and the healing mechanism associated with pellet taphole treatment appears to be different from untreated tapholes. Although results to date indicate no cause for alarm, most investigators are reluctant to draw any conclusions about tree injury from paraformaldehyde taphole pellets on the basis of only one or two year's experience.

Experimental data and analyses of commercial sirups produced from sap obtained from paraformaldehyde-treated tapholes have universally failed to disclose a residue problem stemming from taphole pellet use.

In addition to the indicated benefits of paraformaldehyde taphole pellets on sirup quantity and quality during warm sap seasons, there may be several other advantages which were not emphasized during the Conference. If fall tapping, as discussed by Mr. N. E. Beabes, should become widely adopted by the industry, control of microbial growth in tapholes would appear to be a prerequisite for the extended sap season. Taphole pellets should also be helpful to the sap farmer who operates a sugar bush without additional assistance. This small scale operator can tap several weeks in advance of anticipated sap flow without fear of premature "drying" of the taphole.

X WINTER TAPPING OF SUGAR MAPLES X
by
Newton E. Beabes
Hooversville, Pennsylvania

My sugar bush is located in Somerset County, Pennsylvania at an altitude of about 2,000 feet above sea level. Somerset County is located in the south western corner of the state. Our conventional sugar season runs from about the last week of February to the first week in April.

I first became interested in the flow of sap in the sugar maples while a student at Juniata College, Huntingdon, Pennsylvania where we discussed the flow of sap in a botany class.

Persons interested in winter tapping of sugar maples usually want to know if there can be enough sap obtained to make winter boiling worth while, what the Brix of the sap is, how much sugar sand there is, and what the quality of the sirup produced is. These same questions were in my mind for some time. Not finding answers, I decided in the fall of 1959 to tap a few trees to see if I could find some answers.

After a brief spell of cold weather in the middle of November, the weather turned warmer and on November 20 I tapped ten trees with one container to a tree. When I looked at them on November 21, I found the bucket of the first tree overflowing. Nearly all of them were from one-fourth to three-fourths full. I was sure I had found an answer to the first question. I was sure one could get enough sap to make boiling worth while. Right here I ran head on into my first trouble. I did not have enough sap to boil it in the sugar pan. So I decided to boil it on the kitchen stove. I went into the house and called, "Hey, Mom, I have a lot of sugar water, but in order to find out what kind of sirup it will make I will have to boil it down. How about boiling it on the kitchen stove?" "Not on your life, you are not messing up my kitchen like that; why all the wall paper will fall off the wall with all that steam in here." Well, I couldn't give up that easy. So I came to the conclusion I would have to bribe my wife if I wanted to use the kitchen. I was too poor to buy her a mink or a diamond. We had discussed redecorating the kitchen on a previous occasion. So, after promising my wife I would have the kitchen papered the following spring she gave her consent and I got out a number of pots and pans and started boiling the sap. It took me about 18 hours to boil down the first sap. I tasted it and it was good and considering the long time it had boiled it had a good color. It had quite a bit of sugar sand. I felt good now for I was sure I had at last found answers to my questions. I measured the sap after each run and occasionally boiled some of it.

The sap yield for November was 3.8 gallons per taphole, 8.8 gallons for December, and 7.5 for January. I was so encouraged from the results that on the first of February I put out 400 taps. I ended the season with 4.7 gallons of sap per taphole for February, 3.00 for March, and 5.7 for April, or a total of 33.5 gallons of sap per taphole for the entire season. This was about double the amount of sap obtained by the average producer in our area.

The fall of 1960 started out with unfavorable sugar weather and I had to postpone my experiment. We had a lot of snow and cold until almost the first of April.

The fall of 1961 looked more favorable for winter tapping and on December 2, and 3, I put out 330 taps which I increased to 400 on February 15. The results for the fall of 1961 and spring of 1962 were 4.6 gallons of sap per taphole for December, 3.6 for January, 3.0 for February, 8.1 for March, and 3.5 for April, or a total of 22.8 gallons of sap per taphole for the season. My brother only 10 miles away got only 9 gallons per taphole. He did not open his camp until time for the conventional season which was about the first of March this year.

Sanitizing pellets were not available for the 1959 and 1960 seasons experiment and the trees were retapped twice. Due to this being an experiment we were able to get sanitizing pellets for the 1961 and 1962

season. We inserted one pellet in each of 300 tapholes December 2, and 3, leaving 30 without pellets. The 300 with pellets were given a second pellet in the original taphole March 22 which kept the sap flowing until the end of the season April 8, or four and one-half months. The 30 without pellets had to be retapped in February and again in March. The 70 taps of February 15 did not require a second pellet to keep them flowing until the 8th of April.

From the knowledge I gained from the two years of winter tapping, I have come to the conclusion that one can obtain enough sap to make winter boiling worth while, that the quality of the sirup is equal to that boiled any other season of the year, and that the Brix value of the sap and sugar sand is the same as in the conventional season.

Somerset County, Pennsylvania has a lot of variable weather during the average winter; this makes winter tapping feasible. If you are interested in winter tapping, I suggest you try a few taps as I did and find out how it will work where you live.

FACTORS AFFECTING SUGAR SAND FORMATION

by

John HacsKaylo, and D. R. Davis
Ohio Agricultural Experiment Station, Wooster

SUMMARY

A three-year study was initiated during the 1960 maple sirup season to investigate the environmental factors and the chemical composition of sugar sand as related to sugar sand formation during maple sirup production.

In general it was found that there was a significant difference in the amount of sugar sand formed during maple sirup production with respect to aspect, relative elevation, temperature, time of sap flow, and the calcium malate and malic acid contents.

The amount of sugar sand produced was significantly higher in woods with northern exposures and lowest in those with southern exposures. It was higher on the relatively higher elevations as opposed to the lower elevations. Also it was observed that minimum temperatures during February and March were associated with higher sugar sand formation, and as the season progressed there was an increase in the amount of sugar sand produced. However, soil texture did not significantly affect the amount of sugar sand formed.

The calcium, malic acid, and calcium malate were the only chemical constituents which gave highly significant positive correlations with the amount of sugar sand formed. The undetermined material gave a negative correlation.

There was evidence that the malic acid content was more critical in the formation of sugar sand than the calcium content. This was based on individual sugar sand samples where the malic acid content ratio approached 3 to 1.

During the 1961 season, there was a significant increase in the amount of sugar sand deposited from the first run as compared to the last run. The malic acid content also increased in these samples, but the calcium content was significantly different from the first and last runs, being much higher in the sand obtained from the last run.

Highly significant negative correlations were obtained between the per cent sugar sand deposited and the iron, copper, and boron contents. There was also a high negative correlation between these metallic ions and the calcium content of the sugar sand.

The presence of potassium, magnesium, and molybdenum appeared to have little effect on the formation of sugar sand.

The nonvolatile organic acids of the sugar sand were determined by paper chromatography. The acids determined were malic, citric, succinic, fumaric, and three unidentified ones.

X MAPLE RESEARCH AT VERMONT X
by
James W. Marvin
University of Vermont, Burlington

In a program to select high yielding maple trees, the two important variables are sugar concentration and volume yield of sap. Sugar concentration has been studied by Dr. Taylor (Vermont Agricultural Experiment Station Bulletin 587, March 1956). He found that although the sugar concentration of individual trees varies within a season, and from season to season, there is consistency within a population of trees. Thus the trees with high sugar concentration are always the same trees, and trees with low sugar concentrations are always the same trees. Although volume yield records have been kept by many investigators through the years, they have been for only a few years and on a relatively small number of trees.

We have daily records of sugar concentrations and volume yields on 30 of Dr. Taylor's trees for a 14-year period. Recently we have been analyzing these volume records and attempting to correlate the volume yields with the sugar concentrations.

In general, when the trees are ranked in four quarters according to their volume yields, we found that when the season totals for each of the 14

years were collected for each tree there was a marked consistency. Thus the poorest yielding tree was in the lowest quarter each of the 14 years, the best yielding tree was in the top quarter 11 of the 14 years. The other trees behaved similarly and a clear trend was shown.

When the bar graphs of the sugar concentration and volume yields were compared tree by tree, the high sugar concentration trees were also the high volume trees and the low sugar concentration trees were the low volume trees.

Accurate volume data on individual trees is time consuming and difficult to obtain but sugar concentrations are relatively easy to determine. If the relationship indicated above is supported by additional data then selections can be made on the basis of sugar concentration alone, greatly simplifying the problem.

A more difficult analysis is in progress. The object is to determine whether there is a correlation between variation in sugar concentration and volume yield for individual trees based on all the measurements during the season. No correlation has been found except in one case. When, however, the average sugar concentration for each year and the total volume yield for that year were compared with the same data for each of the 14 years, then a correlation was found. Increased volumes were correlated with decreased sugar concentrations. Unfortunately this kind of an analysis depends upon hundreds of observations over a number of years on the same trees. These data yield very interesting information on the fundamental behavior of maple trees.

At the Proctor Maple Research Farm we have been interested in factors influencing the yield from tapholes for a number of years. Last year we set up an experiment to study the effect of kinds of containers; (metal buckets and cover, plastic bag and plastic spout and tube; the sap was collected in a bucket on the ground); the position on the tree - east, south, and west; and the effect of disinfectants, paraformaldehyde pellets, Clorox, and no treatment as a control. This experiment was replicated once and the results were carefully analyzed with the help of statistics. Our conclusions were that position had no effect on yield in 1962; buckets yielded significantly less sap than tapholes with plastic bags or plastic spouts and tubes; and also disinfectants significantly increased yields but no significant difference was found between Clorox and paraformaldehyde. As is commonly recognized, the effect of disinfectants is greatest at the end of a season.

In addition, last spring we compared two pipeline systems; Lamb and Mapleflo with an 18" drop, both systems vented and unvented, and both systems with and without paraformaldehyde pellets. We found a slight but probably not significant increase in yields from Lamb system over the Mapleflo 18" drop system. Venting reduced yields significantly and the paraformaldehyde pellets significantly increased yields.

X THE MAPLE RESEARCH PROGRAM AT MACDONALD COLLEGE X
(Part I)

by
A. R. C. Jones, McGill University
Quebec, Canada

As many of you know sugaring is big business in many Eastern Canadian farming operations, particularly in Quebec which produced 2.2 million gallons of sirup and 750,000 pounds of sugar in 1961 as compared with 2.49 million gallons of sirup and 800,000 pounds of sugar produced in Canada. Quebec's production alone is more than the total U. S. production. As a result of the importance of this crop our maple program has been oriented to the following phases of maple sap production: 1) Protection of the resource; 2) Demonstration of management methods; and 3) Research. Macdonald College has a 60-acre sugar maple stand divided into 10 groves, and sugaring operations have been under way sporadically in this area since the turn of the century. The sugar bush is 3 miles from the College and the Department of Woodlot Management began sugaring there in 1951. A maximum of 4,000 buckets has been used, but more recently this has been reduced to around 2,700 buckets. I plan to briefly present to you our program under the three headings of Protection, Management, and Research.

The subject of protection covers primarily protection from grazing and control of overtapping. Grazing is rampant in over 60 per cent of Quebec sugar groves, and, as you know, this practice leads to deterioration of the resource over the long term and the eventual replacement of sugar maple by inferior species, such as beech, hemlock, ironwood and hawthorn. Grazing also encourages damage from the sugar maple borer Glycobius speciosus (Say.), one of the worst pests of maple. Our demonstration sugar bush illustrates some of these malpractices as it adjoins the college stock farm and we have the use of one of their maple groves during our sugaring operations. Demonstration is also our answer to the problem of overtapping and we are now using a color-code to ensure that our trees are tapped as follows: 1 bucket for 10-inch trees, 2 buckets for 15-inch trees, 3 buckets for 20-inch trees, and so on. Annual sap-sugar determinations are made with a hand refractometer and the low sap-sugar content trees are being gradually weeded out. This protection work is also stressed in rural field meetings and short courses held in some of the sugaring areas of the province.

Management of the sugar bush is stressed in our silvicultural demonstrations. I have found sugar producers, on the whole, relatively disinterested in the maple resource itself - witness their tendency to permit widespread grazing. Producers are always ready to try new tapping devices, test sap collection systems and all kinds of innovations in the sugarhouse - but what about the tree itself, that priceless source of sap. In most cases nothing constructive is being done to protect or

regenerate the sugar bush, to prevent encroaching softwoods or beech from taking over, or to establish new sweet tree orchards. Perhaps foresters are partly to blame for this, as there is still much to learn about the silviculture of sugar maple.

Our maple management and silvicultural program is designed to develop a healthy, vigorous stand and to produce a high yield of maple sap per acre. This program involved such questions as the most effective cutting methods to regenerate or release sugar maple. We believe that 1/4 to 1/2 acre openings by cutting are more effective than single tree cuttings to bring along the next crop of tappable trees, as sap producing trees become financially mature more slowly than do timber trees. But who can tell us when a sap-producing tree is financially mature? A principle might be stated thus -- that financial maturity is reached when the liquidation value of the tree plus the expectation value of its replacement exceeds the expectation value of the tree itself from sugaring. A useful principle, but the input data for any specific tree is hard to obtain. However, our cutting program has been reasonably rewarding and the increased yield per tap over the 10-year average following the institution of management methods has been quite encouraging. Chart A shows this situation, the average pounds of sugar per bucket in the Arboretum as compared with the average yield from the Quebec North Shore.

Another project is a thinning program in second-growth stands. The primary object in this program is to grow large-crowned trees and favor sweet sap producers. However, what are the specific goals in these areas and what are the economic limitations? Our plan is to test several management alternatives suggested by various authorities. From a review of the literature, Moore et al (1952), Winch and Morrow (1954), Delisle (1956) and Willits (1958), all propose 25 to 30 producing trees per acre and 80 to 100 buckets per acre as being the optimum for a high-producing grove. Huffman et al (1940), Dansereau (1945), Robbins (1949), and Cope (1949), all suggest 50 to 60 trees per acre. Most of these authors, however, agree that a minimum-sized operation is 500 buckets, and that 1,000 to 1,500 buckets is more efficient. Most also agree that bushes with fewer than 25 buckets per acre seldom show a profit. The use of pipeline sap collection and central evaporation should possibly revise these estimates considerably. Our plan is to test these various proposals by establishment of sweet maple orchards and by thinning in young maple stands.

A further study has been the investigation of factors that will aid the re-establishment of sugar maple in degraded stands. Stands where such species as beech, red maple, yellow birch, and hemlock, or certain fern species, are replacing or interfering with the regeneration of sugar maple. The problem of degradation of sugar maple stands is a serious one throughout Quebec.

Finally, I would like to discuss some work that is concerned with the study of new developments in the industry. Since the majority of you are keenly

interested in this work I will spend a few minutes describing it to you. In 1959, as plastic tubing became available commercially, several trials were set up to study the following:

- 1) The various methods of installing pipeline
- 2) The sap yield from different collection systems, and
- 3) The effect of sterilizing agents on yields.

These studies have been supported by Minnesota Mining and Manufacturing of Canada Ltd., and more recently by donations of equipment from Lamb and Sons. In 1959, in addition to taphole sterilization, we tested the yield from 3 M pipeline against plastic bags. This was a simple field trial and showed that we had a lot to learn about hanging pipeline. In 1960 we set up two different 3 M systems, and a Lamb system, and again we found we had more to learn this time about venting pipeline. In both years the difference in yields were of little significance. The main problem was to find a satisfactory method of measuring yields; of comparing the yields from different systems and the elimination of large between-tree variations in sap production.

Finally by 1961 it was decided that a specifically designed trial was necessary to study 1) the yield from tubing, and 2) taphole sterilizers. Two types of sterilizing agents were used and Mr. Graham Jones will describe this work shortly. The 18-inch drop system was tested against the non-drop system. This was the only study that proved statistically significant in 1961. The 18-inch drop system produced greater yields of sap. The trials were conducted in four separate sugar groves that served as replicates. Six treatments were applied in each grove replicate, a treatment comprising a line of 10 trees or 20 taps hooked-up using the 18-inch drop system. The sap from each 10-tree line was collected in a 45-gallon drum. The lines and treatments were as follows:

<u>Line</u>	<u>Treatment</u>
0	Control - no treatment
1	Chlorhexidine 100 mg fast release pellets (500 ml.)
2	Chlorhexidine 500 mg slow release pellets (15 litres)
3	Formaldehyde 100 mg pellets in agar.

The same work was conducted again in 1962 with treatments rerandomized, and this time both buckets and pipeline were used on the same tree. Two different sterilizing agents were used and again there was no significance between treatments. Following the 1961 results, the 18-inch drop system was used throughout our work this year. The two year results need very little interpretation because in all cases with the exception of Sap Production by Groves there was no significance.

We were also very interested in the possibility of taphole damage following the use of sterilizers at the end of the 1961 growing season. No

significance was found. Following the 1962 season taphole closure was measured again. All the 1961 holes have closed more than the 1962 holes. In 1962 the closure for bucket tapped trees and pipeline tapped trees were observed. The thought was that since the bucket holes were open, perhaps the closure might be less for buckets. However, there was again no significant difference between treatments as far as closure was concerned.

Other work under way in our operation is the question of vacuum pumping. One grove of 500 taps was completely hooked-up by pipeline to a vacuum pump. As this grove was extremely flat, vacuum pumping seems the only method to draw sap from this bush. Two types of pumps were tested, the rotary jet type which requires a 5-gallon reservoir and a flexible diaphragm-type. This second pump can be operated without a reservoir and hooked into the pipeline directly giving an equivalent vacuum to the jet pump tested. Because electricity is not available, gas motors were necessary to operate the pumps and freeze-ups gave us some trouble.

A covered evaporator was also added to our operation last year and it made a real difference to the working conditions in the sugarhouse, the quality of the sirup produced, and to fuel economy. Roughly half the amount of fuelwood to process the same amount of sap as was obtained in 1961 seems to be too good to be true and will soon justify the price of the cover, even if other advantages are not considered.

This briefly describes some of the research going on at Macdonald College in maple, and I will now introduce Mr. Graham Jones who will talk to you on the question of tap-hole sterilization.

THE MAPLE RESEARCH PROGRAM AT MACDONALD COLLEGE

(Part II)

Taphole Sterilization

by

G. A. Jones, McGill University
Quebec, Canada

We have heard a good deal at this Conference about taphole disinfection as a means of increasing sap yield, and about the considerable impact it is having on the maple industry in this country. At Macdonald College we have carried out a series of experiments designed to test the effectiveness of disinfecting agents under the conditions found in our Morgan Arboretum. The results obtained are not in agreement with those reported from either Michigan or Vermont and so I hope you will find a description of our work of interest.

I should like to mention at the outset that in addition to Professor A. R. C. Jones and myself, Dr. A. C. Blackwood, Chairman of the Agricultural Bacteriology Department at Macdonald College, has been associated with this work.

In the course of his paper, Professor Jones gave you an idea of the situation regarding our Morgan Arboretum, and described the experimental designs and procedures we used. This has made my task easier insofar as we have used the same experimental set-up in both phases of our work, namely, comparison of pipeline and bucket methods of sap collection and the taphole disinfection experiments. We have been involved with the latter phase only during the last three seasons, so I propose to deal with each season individually.

1960 Season

In this first year we confined ourselves to a very limited experiment involving 14 trees situated in the adjoining Hamilton and East Groves of the Morgan Arboretum. Treated and control taps were on opposite sides (E. and W.) of the same trees, and plastic bags were used for sap collection. The disinfecting agent was paraformaldehyde, made up in plaster of paris pellets each of which contained about 75 mg. of the agent - considerably less, we understand, than pellets used at Michigan contain. Five trees were chosen at random from the group and numbers of bacteria, yeasts and moulds in fresh sap from both treated and control taps were determined on four occasions during the season.

In our area, the season was not one conducive to the growth of micro-organisms. Generally speaking, the counts both of bacteria and yeasts, and of moulds, seldom rose above 100 per ml. of sap, except in the case of some control taps where the sap contained up to 1,000 bacteria and yeasts per ml. towards the end of the season. So far as yields are concerned, taking all 14 trees, treated taps averaged 13.1 gallons/tap, and the untreated ones 13.3 gallons/tap. A statistical t test carried out on the yields, considering treated and control taps as paired samples, showed that there was no significance between the differences.

We attempted to measure residual formaldehyde in the sirups made from treated sap using the chromotropic acid method on distillates of acidified sap solutions, but because this method may not be specific for formaldehyde, I do not wish to quote the results we obtained. The results of our first year's work thus make it difficult to draw conclusions in favor of taphole disinfection under our conditions. Thinking that the very cold weather during most of the season prevented the growth of micro-organisms to the extent necessary for vessel blockage, we therefore decided to continue the experiments in 1961.

1961 Season

In 1961, with the material and financial co-operation of the Minnesota Mining and Manufacturing Company, we set up a much larger experiment using 4 grove replicates of a 5 treatment design, each employing 10 trees with 2 similarly treated tapholes, as outlined by Professor Jones. The treatments were as follows:

<u>Line</u>	<u>Treatment</u>
0	Control, no treatment
1	Chlorhexidine diacetate, 100 mg. fast release pellets
2	Chlorhexidine dihydrochloride, 500 mg. slow release pellets
3	Formaldehyde, 100 mg. in agar ("fast release")
4	Paraformaldehyde, 300 mg. in agar ("slow release")

We selected chlorhexidine as an alternative to paraformaldehyde in view of its actively microbicidal character and non-toxicity to humans. It is marketed by Ayerst, McKenna & Harrison, Ltd., under the trade name of "Hibitane", and this company supplied us with the pellet preparations mentioned. The sap was collected by means of pipelines connected to similarly treated taps and the sap was discharged into large drums.

At weekly intervals, microbial numbers in fresh samples of all the saps were determined. These rose to about 10,000 bacteria and yeasts per ml., except in the case of chlorhexidine dihydrochloride, which seemed to exert some inhibitory action. Numbers of moulds in the sap were generally below 100 per ml. in all cases throughout the season. When sap yields were examined, however, formaldehyde at first sight appeared to have been more effective, but an analysis of variance of all the yields and t tests between the yield results from each treatment and the control, showed no significance, and again the correlation between yields and bacterial numbers was very poor.

Analysis of sirups for residual formaldehyde was carried out by vapor phase chromatography. We could not detect any free formaldehyde residue whatsoever in any sample. Analysis of sirups for residual chlorhexidine by spectrophotometry on ether extracts showed the presence of 0.27 p.p.m. in the first-made sirup and 0.02 p.p.m. at the end of the season. No information is available on permissible levels of this agent in food materials, but these figures indicate that the amounts of residue in the sirups were extremely low.

Inevitably, our conclusions from the 1961 results on the usefulness of taphole disinfection must again be neutral.

1962 Season

Our results for the season immediately past are not yet complete, but I will outline the experiment we set up and summarize the results we have so far.

This year, we used the same set of trees as last year, rerandomising the treatments and collecting sap from one hole in each tree by means of pipeline and from the other by means of a bucket. This design originated from the idea that a crudely covered bucket hanging on an open spile might allow the entry of adventitious microorganisms to the taphole, whereas a closed pipeline system would not. The chemical treatments were the same as in 1961,

except that in place of our own agar pellets containing paraformaldehyde we substituted Mr. Lamb's pressure pellets.

Sap yields were recorded and microbial numbers determined by the usual methods. The counts of bacteria and yeasts reflect the fact that the season was for us a very warm one. Numbers rose to around a billion per ml. of sap towards the end of the season regardless of treatment, although mould counts were generally below 100 per ml. Sap yields were again rather variable and there was no statistical significance between yield differences, and no correlation between yields and microbial counts.

An observation which to our minds has considerable significance was made by Professor Jones, namely, that groups of trees giving the highest yields in 1962 were the same as those giving the highest yields in 1961, when the treatments applied were not the same. We are therefore inclined to regard our results in toto as being indicative of large between-tree variations in sap yield, regardless of disinfection treatment and conclude that under conditions obtaining in the Morgan Arboretum, disinfection of tapholes has had virtually no value so far as increasing sap yields is concerned.

X CONCENTRATION OF SAP BY FREEZING X

by

Edgar E. Stinson

Eastern Utilization Research and Development Division

In the concentration of maple sap to sirup vast quantities of water must be removed. This can be accomplished by either of two methods - vaporization, or freezing. The common method and the one which we all use is vaporization, where the water is evaporated as steam from boiling sap. When oil is used as fuel, the fuel cost amounts to \$0.45 to \$0.75 per gallon of finished sirup. I am sure that we have all wondered if there wasn't a cheaper way of concentrating sap. What about freezing out of the water, or at least a portion of it, so that there would be less to remove by evaporation?

Many have observed that when sap freezes due to cold weather, the Brix of the remaining liquid is higher. Obviously, the liquid has become higher in sugar and the ice lower. Would it be profitable to throw this sap ice away, or should it be partially or completely melted and the melt evaporated together with the liquid?

There is nothing in the literature that gives the answer as far as maple sap is concerned. Therefore, experiments were set up which not only gave the answers to these questions but produced some startling additional results.

Preliminary work was done using cane sugar solutions and then repeated using a 2° Brix sap. Two hundred grams of sap were frozen in each of several ways. The effect of rate of freezing was studied by rapidly and by slowly freezing samples of sap. Also examined was the effect of the extent of freezing upon the concentration of solids in maple sap as well as the effect of completely freezing sap and then partially thawing it.

The methods of separating liquid and ice were also studied. The ice and sap or ice and melt were separated by pouring the liquid off, draining the ice as it melted, crushing and rinsing the ice with water, dunking the ice in fresh sap, and centrifuging.

It was found that the liquid froze first at the surface, then at the bottom, and finally along the sides of the container with the zone of freezing gradually extending into the interior. We tested scrapings from the surfaces of several samples. The sugar content of these scrapings was high, as much as 26° Brix. However, these scrapings contained only a small fraction of the total sugar in the sample.

We first investigated changes in sugar concentration in two situations: first, where liquid sap was being progressively frozen and, second, where sap was completely frozen and then partially melted. The first situation would be equivalent to the sap producer finding a container of sap during or immediately after a cold spell. There the sap is partially frozen with liquid sap and ice in the container. The second situation would correspond to finding a container of sap after the completely frozen sap had partially melted but still had a piece of ice floating in the liquid sap.

The method of freezing or thawing was found to produce little, if any, effect. Therefore, only the case of partial freezing will be discussed. Containers of sap were withdrawn from the freezing chamber at intervals as the sap froze. The percentage of the sap remaining as liquid and its Brix were measured and the amount of sap as ice and the Brix was obtained by difference. So that the data would be comparable, all calculations were on the basis of 100 gallons of 2° Brix sap. The value of the 2.33 gallons of sirup that could be made from 100 gallons of sap was \$11.63, using the average sirup price of \$5.00 per gallon. In calculating the savings from decreased fuel oil requirement due to removal of water as ice, the price of oil used was assumed to be \$0.15 per gallon, and that one gallon of fuel oil would evaporate 13 gallons of water, and that the maximum cost to evaporate the 100 gallons of sap would be \$1.15.

When the liquid is recovered by rapid draining it was found that for a sample which contained 70% ice, only 48% of the sugar was in the drained

liquid. Discarding the ice would have caused a loss of 52% of the sugar having a potential value of \$6.05, and saved only \$0.80 in fuel, for a net loss of \$5.25. With smaller quantities of ice the loss is somewhat diminished. Thus, when the ice is only 57% of the sample, discarding the ice would result in a loss of \$4.45 in sirup and a saving in fuel of \$0.65, or a net loss of only \$3.80. In no instance was it found profitable to discard the ice obtained after rapid draining.

The rate of freezing has little effect upon the recovery of sugar. Since all of the sugar was not removed from the rapidly drained ice, it was reasoned that a higher percentage recovery could be obtained if the ice were allowed to thaw and the liquid melt continuously removed. This would correspond to a situation where the sap ice was allowed to melt slowly on a wire screen and the melted sap collected in a tank below. This would cause a continuous rinsing of the ice by freshly melted sap.

The data showed a lower retention of sugar by the ice. Thus, when 53% of the sample had been melted, discarding the ice effected a net loss of only \$1.15 compared to the loss of \$3.10 in the previous experiment when a comparable amount of sap, 44%, was discarded as rapidly drained ice. These two experiments show that draining partially melted sap is not an effective means for concentration. This may be due to either incomplete separation of pure water as ice from the sap or occlusion of sugar sap in the pure ice.

The latter possibility was tested by crushing and centrifuging the ice to remove the freed liquid. When the sample contained more than 79% ice, it was not profitable to discard the ice even though centrifuging removed more of the liquid from the ice. At 79% ice the potential loss of sugar in terms of sirup would be \$2.00 and the gain in reduced fuel cost would be only \$0.90, with a net loss of \$1.10.

However, when the liquid separated by centrifuging is more than 30% of the sample, it is profitable to concentrate the liquid and discard the ice. At 30% liquid the gain from lower fuel requirement and decreased loss in sirup discarded as ice resulted in a net profit of \$0.05. This increases to a maximum profit of \$0.50 when the liquid was 44% (ice 56%) of the sample. At this and lesser percentages the centrifuged ice contained no sugar so that further melting served no purpose as it increased the oil consumption without any gain in sirup recovery.

Better separation of sugar from ice was obtained by crushing the frozen sap, rinsing it with successive portions of 2° Brix sap, and centrifuging, but very little additional concentration was achieved because of the diluting effect of the rinse liquid. As rinsing is an additional operation, it would only add to the cost and must be considered as contributing to net loss. Little is to be gained from rinsing.

Two additional experiments were conducted. One consisted of determining the amount of the sugar that adheres to the surface of the ice. Scrapings from a very thin layer of the ice produced a melt that was 26° Brix. This suggested that dunking the blocks of frozen sap in a fresh batch of sap might wash this sugar off and reduce the amount of sugar which would be discarded as ice. This was tried, but the total amount of sugar removed from the ice by dunking was so small that it was insignificant.

The other experiment was to determine the effect of stirring maple sap as it froze. This, too, proved to have little or no effect on the amount of sugar entrained in the sap ice.

SUMMARY

1. Do not discard ice from partially frozen or melted sap. The value of sugar lost exceeds the gain from lower oil consumption.
2. Dunking frozen sap in plain water or fresh sap has no advantage.
3. Crushing and centrifuging justifies discarding ice after 30% thawing, and is entirely justified after 55% thawing.
4. Rinsing and centrifuging the crushed ice has very little, if any, advantage over simply crushing and centrifuging the crushed ice.

MAPLE TREE DISEASES (Part I)

Maple Blight...A Problem Of Sugar Maple Initiated By Defoliation by

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Maple blight was first observed in 1957 in northeastern Wisconsin. The blight differed from maple dieback or decline in that trees of all ages were affected and the rate of infection apparently was more rapid. Disease severity, expressed as a percentage of dead trees, was greatest in the smaller size classes.

Symptoms of the Disease - The most conspicuous symptom was the development of clumps or tufts of sprouts at the base of dead terminals. In most cases death of branches was not progressive and in 1958 dissection of diseased terminals showed that whatever had killed them had ceased operating.

Search for Possible Causes - Isolations from the diseased trees produced no known pathogens and inoculations of healthy trees with the fungi on blighted trees produced no symptoms of the disease.

When it was discovered that the blight had occurred only in areas that had been previously defoliated by insects, a series of tests were run to determine the effects of defoliation on the tree. It was found that artificial defoliation during a critical period from about the middle of July to the middle of August caused the most severe bud mortality the following year. In addition climate and action of root pathogens increased the effects of defoliation. Thus, while maple blight was shown to be due primarily to defoliation the severity of symptom expression was influenced by fall frosts and winter conditions following the defoliation and by the subsequent attack of root rot fungi, especially Armillaria mellea.

X MAPLE TREE DISEASES
(Part II)

Two Diseases of Sugar Maple In The Northeast
by

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Dr. David Houston has described a complex situation that has led to the death of numerous sugar maples in the Lake States. The diseases of sugar maple in the Northeast are no less complicated. Many fungi and bacteria have been found on sugar maples in this region. Recently I compiled a list of those reported in the literature or represented by collections in herbaria -- and the list contained more than 150 different organisms. Most of them were saprophytes, but many others were either weak or virulent pathogens. Some of the pathogens cause severe damage but many others have little effect on the normal functioning of the tree.

I should like to discuss two disease conditions in the sugar bush of the Northeast -- each of which may be of importance to the sugar maple industry. The first is usually called sugar maple decline, but is sometimes referred to as maple dieback. This is a widespread disease. It is common on sugar maples in southern Vermont and New Hampshire, in New York, and in other places throughout the range of sugar maple in the Northeast. Hundreds of trees have died and countless thousands are affected to varying degrees.

Decline is most severe on roadside trees, but it also occurs in the forests and in the sugar bush. Decline is a term used to describe a gradual deterioration in the health and vigor of trees. In sugar maple it may be expressed by the death of the ends of branches, often by the death of entire branches in the tree crown, and sometimes by the death of the entire tree.

This condition in sugar maple may be caused by various adverse factors or combinations of factors. No single pathogen seems to be responsible for the trouble, and the complexity of the malady has baffled several investigators. We are forced to engage in some speculation in attempting to explain the cause of maple decline. Nevertheless, there is quite a bit of reliable information available to aid us in an explanation of the probable cause of maple decline.

Wherever maple decline has been investigated it has been found that affected trees have been subjected to unfavorable conditions. Often these unfavorable conditions have resulted from a combination of adverse factors. For example, defoliating insects have attacked the trees. And in many affected areas maples were defoliated once, twice, or even three times during the decade preceding the development of symptoms of decline. Also, in many places heavy frosts during late spring have caused severe defoliation. Deficiencies in rainfall, especially during the growing season, may be an important factor in this disease situation. Many dieback sugar maples have *Verticillium* wilt infections in their crowns, and some have numerous *Phytophthora* bleeding cankers on their trunks. Roadside trees are further devitalized by restriction of root area, compaction of soil, depletion of soil nutrients, changes in grade, run-off from salted roads, general lack of care, and overmaturity.

Dr. Craig Hibben conducted research on sugar maple decline in New York State. Recently he published results of his studies in *Phytopathology*. It is interesting to note that in seven permanent woodland plots established in 1960 there was no significant increase in branch dieback or tree-to-tree spread from 1960 to 1962. Root excavations revealed many necrotic root ends but only a little rootlet necrosis of feeding roots.

Hibben found that *Armillaria mellea* was frequently associated with the dead roots. Neither pathogenic nor physiopathogenic cankering was significantly involved on above-ground parts of trees. And there was no evidence of wilt pathogens. He was unable to isolate any one organism from necrotic tissue consistently, and inoculations made with the several organisms isolated did not reveal high virulence of any of the organisms. Nematode analyses of soil and roots were inconsistent, and bud and bark patch-grafts failed to reveal evidence of a virus. Hibben concluded that maple decline in New York State was probably the result of a complex of adverse environmental factors.

When we speak of maple decline throughout the Northeast we refer to a general decadence of maple. Some maples may be severely damaged or killed by

Verticillium wilt, others may be damaged by Phytophthora bleeding cankers, still others may be suffering from other specific diseases, but maple decline should be reserved as a term to apply to a diseased condition brought about by a complexity of adverse conditions.

It must be confessed that we actually do not have much specific information about this maple decline. Considerable research would undoubtedly be required to determine the precise role of each factor in the development of the disease. Some of the factors mentioned may be essential to disease development and others may be relatively unimportant. The condition of sugar maple, and the possible effect of the decline on an important industry indicates that additional research on this problem is needed and justified.

The second disease that I wish to discuss does not have a specific name, nor is its cause understood. It is a canker disease and was first called to our attention by John Zimmerman of this group. Affected trees may have a few or hundreds of cankers on the branches and main stem. Most of the cankers are small -- that is, the size of a dime or smaller. But many are much larger. The bark covering the necrotic portion of the canker usually remains intact for several years and callous tissue frequently forms around the edges of the cankers. The branches or stems of some trees contain so many small depressed cankers surrounded by callous that they have a weird appearance. The mutilations on some branches remind one of pox marks.

Pathologists and foresters at the Pennsylvania State University are conducting research on this disease. They have found several fungi on the dead bark covering the cankers. One of the most commonly found is a species of Pyrenochaeta. Yet inoculations made with this fungus and with others isolated from diseased tissue have so far failed to reveal the cause of canker formation.

The cankers occur on all sides of the branches and on trees of all sizes and ages. The canker condition seems to be as severe on optimum sites for sugar maple as on poorer sites. The disease has been found from Maryland to New Hampshire and Vermont. Some of the sugar bush operators in Pennsylvania estimate that this disease has caused a 10 to 15 per cent reduction in sugar production, but no precise information is available on this point.

As with the sugar maple decline, we need to understand the cause of this canker disease and the conditions influencing disease behavior before we can hope to devise control measures.

MICROBIOLOGY OF MAP SAP

by

Aaron E. Wasserman

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The relationship between maple sap, maple sirup and microorganisms has been recognized for many years. Edson, between the years 1909 and 1912, published a series of papers showing the increase of bacterial population in sap as the temperature increased. He noted the development of invert sugar and dark sirup, but did not really relate them. In recent years the studies of Naghski, Frank, and Willits at this Laboratory, and Sheneman, Costilow, and Robbins at Michigan State University have done much to add to our knowledge of the microorganisms in sap. Naghski, Willits, and Frank have related microbial growth with the development of color and flavor in maple sirup.

There are a variety of organisms present in sap. Edson identified fluorescent and non-fluorescent pseudomonads, pink cocci, pink, grey, and white yeast, and mold. Naghski showed that pseudomonads and other microorganisms were responsible for the "drying up" of the taphole. Sheneman and Costilow identified a number of these taphole organisms. They found 67% of the organisms isolated were pseudomonads and better than 50% of these were Pseudomonas geniculata.

The interesting thing about all of these organisms is that they are "psychrophiles" - they will grow at temperatures below 57°F. As a matter of fact some Pseudomonas can continue to grow at temperatures as low as 20°F. Thus, while low temperatures will reduce the rate of growth and help keep down the number of bacteria in sap, they will not prevent the growth of the organisms. Furthermore, even though growth is stopped the enzymes of the bacteria may be continuing to break down or change the components of the sap.

Why are we concerned about the organisms in maple sap? Several reasons can be presented. (1) The prevention of "drying up" of tapholes. As recently as 1952 there were publications discussing the "drying up" of tapholes as being due to the wind and temperature. We know now the wind has nothing to do with this problem, and the weather is involved, but not as claimed. Naghski demonstrated that bacterial growth occurred in the tapholes as the weather became warmer and that dried out tapholes had large numbers of organisms. Sheneman, et al. showed that tapholes could be made to "dry up" by adding numbers of bacteria. Ching and Mericle studied very thin slices of wood from around the tapholes and found there was a gummy substance in the taphole that contained bacteria and yeast. The tubules of the wood were plugged with this gummy material and bacteria were even found in the wood tissue at a distance from the surface. (2) The prevention of sap spoilage by microorganisms. All deleterious conditions except one, are caused by microorganisms. The single exception is "buddy" sap which I

shall discuss later. Saps may become colored - "red" sap could be caused by the excessive growth of pink cocci or the pink or red yeast; "green" sap is due to the excessive growth and pigment production by pseudomonas, "milky" sap could be caused by yeast growth. The organisms that ferment the sugar in the sap would cause "sour" sap. "Ropy" sap is caused by the production of polysaccharides and "ropy" sirup is probably the result of bacterial action in sap which does not show up until the sap is evaporated. (3) The roll of the organisms involved in maple flavor formation. It is known that sterile sap gives a sirup with essentially no maple flavor. There are also chemical changes due to heating, but these will not be discussed here. The works of Naghski, Frank, and Willits showed that probably only the Pseudomonas organisms are involved in producing flavor precursors, and only certain strains of Pseudomonas at that. We are studying these organisms further to see whether we can take advantage of this property of these organisms and use them to help us produce the amount of maple flavor we want for the particular purpose it is to be used for. But this will be discussed later. The other organisms (yeast and bacteria) may form invert sugar that will cause caramel flavor and dark color.

Sanitation - Because of the activities of the organisms it is necessary for us to practice sanitation or "good housekeeping" in maple sap processing. We have talked about sanitation in our field trips and maple schools so I will only touch on it here.

Taphole - At the taphole it is still recommended that a hypochlorite rinse be used to reduce the number of bacteria entering the tap. To further reduce the numbers the spout should be soaked in hypochlorite solution before inserting in hole.

This season was the first for the use of the paraformaldehyde pellets. We have heard other papers today and yesterday on the effectiveness of the pellets so I will not go over this phase again. However, some time ago we began to wonder whether the formaldehyde would inhibit all the bacteria and what effect temperature and the number of organisms had on its action. This was of utmost importance for we know that some natural fermentation was required for flavor development and the question arose whether it would be possible to have controlled fermentation of sap from paraformaldehyde treated tapholes. Studies were begun with sap, either alone or with 5 p.p.m. (parts per million) of formaldehyde, which was found to be the maximum concentration in about 70% of the saps. Sap was inoculated with 1,000 or 10,000 bacteria per ml. and incubated at 45° F. or 80° F. The formaldehyde did not stop the growth of the bacteria at 80°, but at 45° there was definite decrease in the rate of growth, which was greater with the 1,000 than the 10,000 bacteria per ml. inoculum. In another experiment we started with 1,000; 10,000; 100,000; and 1,000,000 bacteria per ml. in sap with or without 5 p.p.m. formaldehyde. At 45° there was an inhibition period of at least 24 hours due to the

formaldehyde before growth began. This happened regardless of the number of bacteria present. So, it seems that when the sap is flowing and there is at least 5 p.p.m. formaldehyde present, the growth of the organisms will be held back for about 24 hours, which should give a producer a chance to pick up the sap. Since the bacteria will grow out there does not seem to be any need to worry whether treatment with the paraformaldehyde pellet will kill off all the bacteria and prevent the formation of the factors required in the development of the maple flavor.

The use of the hypochlorite rinse should be continued even with the pellet. It will give the pellet a better chance to do its work.

Collecting Equipment - I would like to state only that sanitation of collecting equipment is important, and proper cleaning is the best solution and necessary even with the use of the pellets. Washing equipment immediately at the end of the season prevents the formation of a film of sugar from the sap which would allow the bacteria to grow.

Storage - Sap storage is best carried out in metal tanks preferably situated outdoors where the low temperature will help hold down the growth of the bacteria. A sheet of plastic over the top will allow the penetration of the ultraviolet rays of the sun, which also kills microorganisms and will help to prevent sap spoilage for a longer period of time. Tanks stored indoors should be protected by UV lamps which can be easily installed.

Other Aspects of Our Research - "Buddy sap", as mentioned earlier, is not caused by microbial action but is due to the physiology of the tree. However, if the "buddy" sap is fermented with Pseudomonas geniculata under controlled conditions the factors that are responsible for the "buddy" flavor are removed and a pleasant tasting sirup results. While the sirup is dark amber in color, it is still a good commercial sirup.

Controlled Fermentation - As you well know the flavor of maple sirup can vary from time to time, and there is no way to predict the flavor. The studies of Naghski, Frank, and Willits have shown that as much as a four-fold increase in flavor can be obtained by selected strains of Pseudomonas geniculata. It would seem, therefore, that by deliberately inoculating the sap with these organisms it would be possible to control the product. If quantities of Pseudomonas geniculata are added to maple sap and allowed to ferment under controlled conditions the sirup made from such sap has good, strong maple flavor. More important, the flavor can be reproduced in a more uniform manner. Controlled fermentation could be an important step in the central evaporator where large quantities of sap could be treated with the bacteria to produce sirups to meet special requirements for particular end uses.

Theoretical Aspects - The Pseudomonas organisms do not invert sugar, therefore, it must use some other component in the sap as a source of energy and growth. The average composition of maple sap shows that the component

present in greatest concentration next to sucrose is malic acid. While there is about 100 times more sugar than malic acid in sap, there is about 10 to 100 times more of malic acid than any other component. Today I heard some interesting facts about malic acid in sugar sand from Dr. Davis, which makes our work more interesting. Pseudomonas does use malic acid. We used an artificial sap containing salts and malic acid. If no nitrogen is present the bacteria will not grow, but the enzymes that are present in the cells in the medium still remove the malic acid. If nitrogen is available, about twice as much malic acid disappears and good cell growth occurs. When the same experiments were done with sap similar results were obtained. It is difficult, however, to add things to maple sap to try to study their influence on the growth of the bacteria without affecting the flavor. These metabolic processes may give a clue to the pathway of maple flavor development from the sap flavor precursors. More work is being done on this problem and we hope to be able to report further at future meetings.

LIST OF ATTENDANCE

<u>Name</u>	<u>Organization</u>	<u>Address</u>
Adams, R. A.		Cuttingsville, Vt.
Anderson, A., Jr.		Long Eddy, N. Y.
Anderson, A., Sr.		Long Eddy, N. Y.
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Anderson, E. P.		Kennedy, N. Y.
Anderson, E. P. (Mrs.)		Kennedy, N. Y.
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Ayres, F. (Mrs.)		Shaftsbury, Vt.
Ballinger, R. A.	Economic Research Service, USDA	Washington, D. C.
Baltus, J.	Wisconsin Dept. of Conservation	Wausau, Wisc.
Barnard, J. E.	Pennsylvania State University	University Park, Pa.
Barraclough, K. E.	University of New Hampshire	Durham, N. H.
Bascom, K. E.	New Hampshire Maple Producers' Association	Alstead, N. H.
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Beabes, N. E.		Hooversville, Pa.
Bell, R. A., Jr.	Eastern Util. Res. & Devel. Div.	Philadelphia, Pa.
Benjamin, E. J.	Fred Fear Company	Brooklyn, N. Y.
Bennett, A. W.	The Great Atlantic and Pacific Tea Company, Inc.	New York, N. Y.
Black, W. R.		Rockwood, Ontario, Canada
Buell, B. C.	New York State Dept. of Agriculture	Albany, N. Y.
Buist, J. A.	Minnesota Mining of Canada	London, Ontario, Canada
Burton, D. L.	Agricultural Marketing Service, USDA	Washington, D. C.
Callward, F. M.	University of Connecticut	Storrs, Conn.
Clark, G., Jr.	Prospect Enterprises, Inc.	Stamford, N. Y.
Clark, G., Jr. (Mrs.)		Stamford, N. Y.
Clark, W. S.		Wells, Vt.
Clark, W. S. (Mrs.)		Wells, Vt.
Coombs, R. G., Jr.	Coombs Maple Products	Jacksonville, Vt.
Costilow, R. N.	Michigan State University	East Lansing, Mich.
Cowen, W. F., Jr.	Agricultural Extension Service, USDA	Columbus, Ohio
Croteau, G.	Les Producteurs De Sucre D'Erable De Quebec	Levis, Quebec, Canada
Curtis, R. K., Jr.		Newfoundland, Pa.
Davis, D. R.	Ohio Agricultural Expt. Station	Wooster, Ohio
Davis, E. P.	Vermont Department of Agriculture	Montpelier, Vt.
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Farrand, E. P.	Pennsylvania State University	University Park, Pa.
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Franklin, D. B.	Burke Mt. Maple Company	Newport, Vt.
Grassl, E. T.	Pharmacia Fine Chemicals, Inc.	New York, N. Y.
Hacskaylo, J.	Ohio Agricultural Experiment Sta.	Wooster, Ohio
Hall, H. D.		Somerset, Pa.
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Houston, D. R.	Forest Service, USDA	New Haven, Conn.
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Huber, E.	New York State Conservation Dept.	Altamont, N. Y.
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Huxtable, R. B.	Sugar Bush Supplies Co.	Lansing, Mich.
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Loutfi, S. M.	The Coca Cola Export Corp.	New York, N. Y.
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Moore, T. J.	Pennsylvania State University	University Park, Pa.
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